A PROSPECTIVE COMPARATIVE STUDY TO COMPARE THE RELEVANCE OF USG GUIDED MEASUREMENT OF ANTERIOR SOFT TISSUE THICKNESS OF NECK AND NECK CIRCUMFERENCE IN AIRWAY ASSESSMENT

Dissertation submitted

in the partial fulfillment of the requirements

for award of the degree

M.D (Anaesthesiology)

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TAMIL NADU

APRIL 2016

CERTIFICATE

This is to certify that this dissertation entitled "**A PROSPECTIVE COMPARATIVE STUDY TO COMPARE THE RELEVANCE OF USG GUIDED MEASUREMENT OF ANTERIOR SOFT TISSUE THICKNESS OF NECK AND NECK CIRCUMFERENCE IN AIRWAY ASSESSMENT"** submitted by **Dr.PERUMAL PILLAI.A** in partial fulfillment for the award of the degree Doctor of Medicine in Anaesthesiology by The Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide work done by him at GOVERNMENT KILPAUK MEDICAL COLLEGE, CHENNAI during the academic year 2014-2016.

Prof. Dr.Narayana Babu, M.D.,DCH.,
Dean,
Government Kilpauk Medical College,
Chennai-10 .

Prof.Dr. T.Murugan, M.D.,D.A.,
Professor & HOD,
Department of Anaesthesiology,
Govt Kilpauk Medical College,
Chennai-10

CERTIFICATE

This is to certify that the dissertation entitled **TO COMPARE THE RELEVANCE OF USG GUIDED MEASUREMENT OF ANTERIOR SOFT TISSUE THICKNESS OF NECK AND NECK CIRCUMFERENCE IN AIRWAY ASSESSMENT A PROSPECTIVE COMPARATIVE STUDY** submitted by **Dr. A.PERUMAL PILLAI**, in partial fulfillment for the award of the degree of Doctor of Medicine in Anaesthesiology for the april 2016 examination by the Tamilnadu Dr.M.G.R. Medical University,Chennai , this is a bonafide original research work done by him in the department of Anaesthesiology,Govt.kilpauk Medical College, under my guidance and supervision

PROF.Dr.T.Murugan M.D.,D.A.,
Professor and HOD of Anaesthesiolgy,
Govt.Kilpauk Medical College,
Chennai -10

PROF.DR.A.Chandrasekar M.D.,
Professor of Anaesthesiology,
Govt.Kilpauk Medical College,
Chennai -10

DECLARATION

I, **Dr.A.PERUMAL PILLAI**, solemnly declare that this dissertation, entitled "**A PROSPECTIVE COMPARATIVE STUDY TO COMPARE THE RELEVANCE OF USG GUIDED MEASUREMENT OF ANTERIOR SOFT TISSUE THICKNESS OF NECK AND NECK CIRCUMFERENCE IN AIRWAY ASSESSMENT"**, has been prepared by me, under the expert guidance and supervision of Prof. Dr.T.Murugan, M.D.,D.A Professor and HOD, Department of Anaesthesiology, Government Kilpauk Medical College and Hospital, Chennai and submitted in partial fulfillment of the regulations for the award of the degree M.D.(Anaesthesiology) by The Tamil Nadu Dr. M.G.R. Medical University and the examination to be held in April 2016.

This study was conducted at Government Kilpauk Medical College Hospital, Chennai. I have not submitted this dissertation previously to any university for the award of any degree or diploma.

Place: Chennai (DR.A.PERUMAL PILLAI)

Date:

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The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "To compare the relevance of USG guided measurement of anterior soft tissue thickness of neck and neck circumference in airway assessment" – For Dissertation Purpose" submitted by Dr.A.Perumal Pillai, MD (Anaesthesiology), Govt. Kilpauk Medical College, Chennai - 10.

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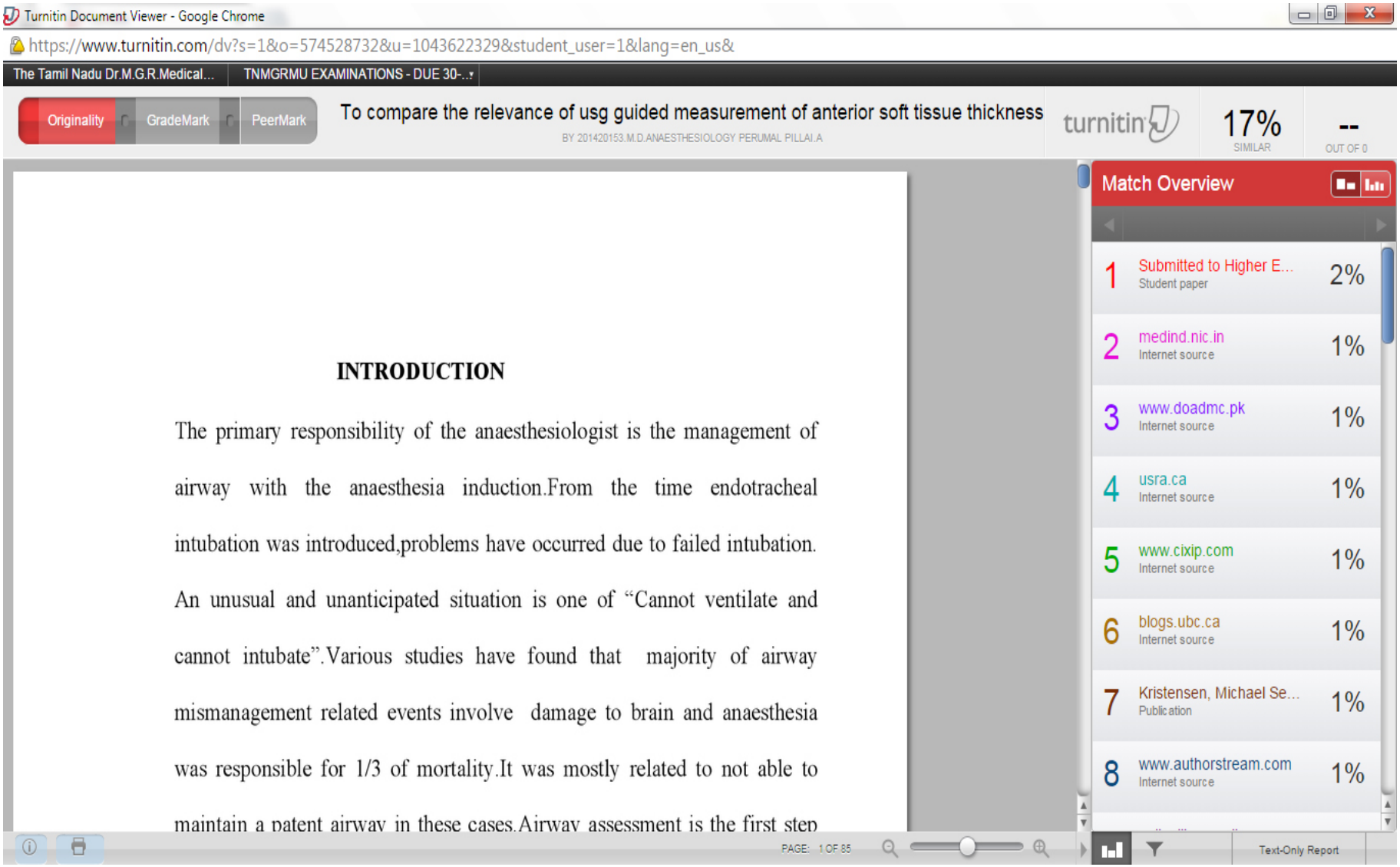
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INTRODUCTION
The primary responsibility of the anaesthesiologist is the management of airway with the anaesthesia induction.From the time endotracheal intubation was introduced,problems have occurred due to failed intubation. An unusual and unanticipated situation is one of "Cannot ventilate and cannot intubate".Various studies have found that majority of airway mismanagement related events involve damage to brain and anaesthesia was responsible for 1/3 of mortality.It was mostly related to not able to maintain a patent airway in these cases.Airway assessment is the first step
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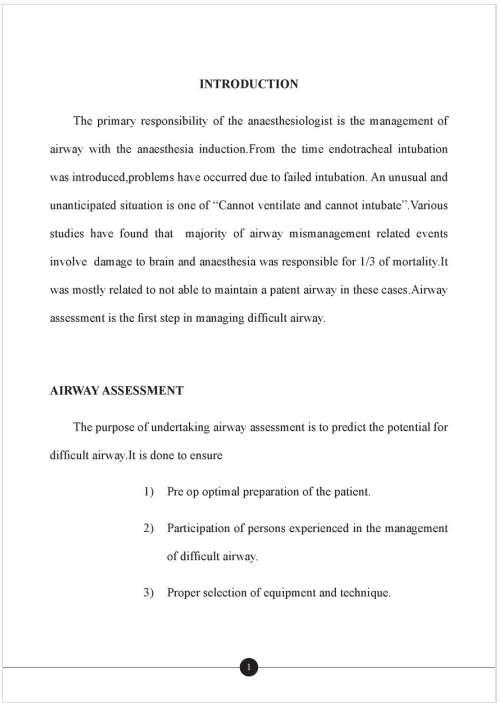

INTRODUCTION

The primary responsibility of the anaesthesiologist is the management of airway with the anaesthesia induction.From the time endotracheal intubation was introduced,problems have occurred due to failed intubation. An unusual and unanticipated situation is one of "Cannot ventilate and cannot intubate".Various studies have found that majority of airway mismanagement related events involve damage to brain and anaesthesia was responsible for 1/3 of mortality.It was mostly related to not able to maintain a patent airway in these cases.Airway assessment is the first step in managing difficult airway.

AIRWAY ASSESSMENT

The purpose of undertaking airway assessment is to predict the potential for difficult airway.It is done to ensure

1) Pre op optimal preparation of the patient.
2) Participation of persons experienced in the management of difficult airway.
3) Proper selection of equipment and technique.

CONTENTS

LIST OF FIGURES

TABLES

INTRODUCTION

The primary responsibility of the anaesthesiologist is the management of airway with the anaesthesia induction.From the time endotracheal intubation was introduced,problems have occurred due to failed intubation. An unusual and unanticipated situation is one of “Cannot ventilate and cannot intubate”.Various studies have found that majority of airway mismanagement related events involve damage to brain and anaesthesia was responsible for 1/3 of mortality.It was mostly related to not able to maintain a patent airway in these cases.Airway assessment is the first step in managing difficult airway. (3)

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1) Pre op optimal preparation of the patient.
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The essential components of airway assessment are history taking,general examination and specific indices to predict difficult airway.

Previous anaesthesia records may reveal a history of difficult airway. History of previous surgery,burns,trauma or tumour in and around the oral cavity,neck or cervical spine should be included in history. Initially the airway assessment was carried out by single factors like Mallampatti's oropharyngeal classification,thyromental distance,head and neck movement and inter incisor gap.But when it was realized that the visualization of larynx during intubation is affected by many factors, the concept of multivariate factor analysis came into existence.Even with the use of multivariate factors there have been instances when a patient predicted to have easy intubation had an difficult intubation and vice versa.In the last few years,ultrasonogram has been gaining popularity and practical applicability in the hands of anesthesiologist.There have been many studies using ultrasonogram to assess the airway of patients and to predict difficult intubation.In ultrasound also various parameters have been analysed and measured and each one is having it's own significance to predict the difficult airway. (23,24,25)

ULTRASONOGRAM TO MEASURE THE PRETRACHEAL SOFT TISSUE THICKNESS

The patient's pretracheal soft tissue thickness is measured at three levels

1) Vocal cord

2) Thyroid isthmus

3) Suprasternal notch

NECK CIRCUMFERENCE:

Measured in cm at the level of thyroid notch.

AIM OF STUDY

The aim of the study is to compare the relevance of USG guided measurement of anterior soft tissue thickness of neck and neck circumference in airway assessment.

OBJECTIVES

1) To study the usefulness of ultrasonogram guided measurement of anterior soft tissue thickness of neck and neck circumference in predicting difficult airway.

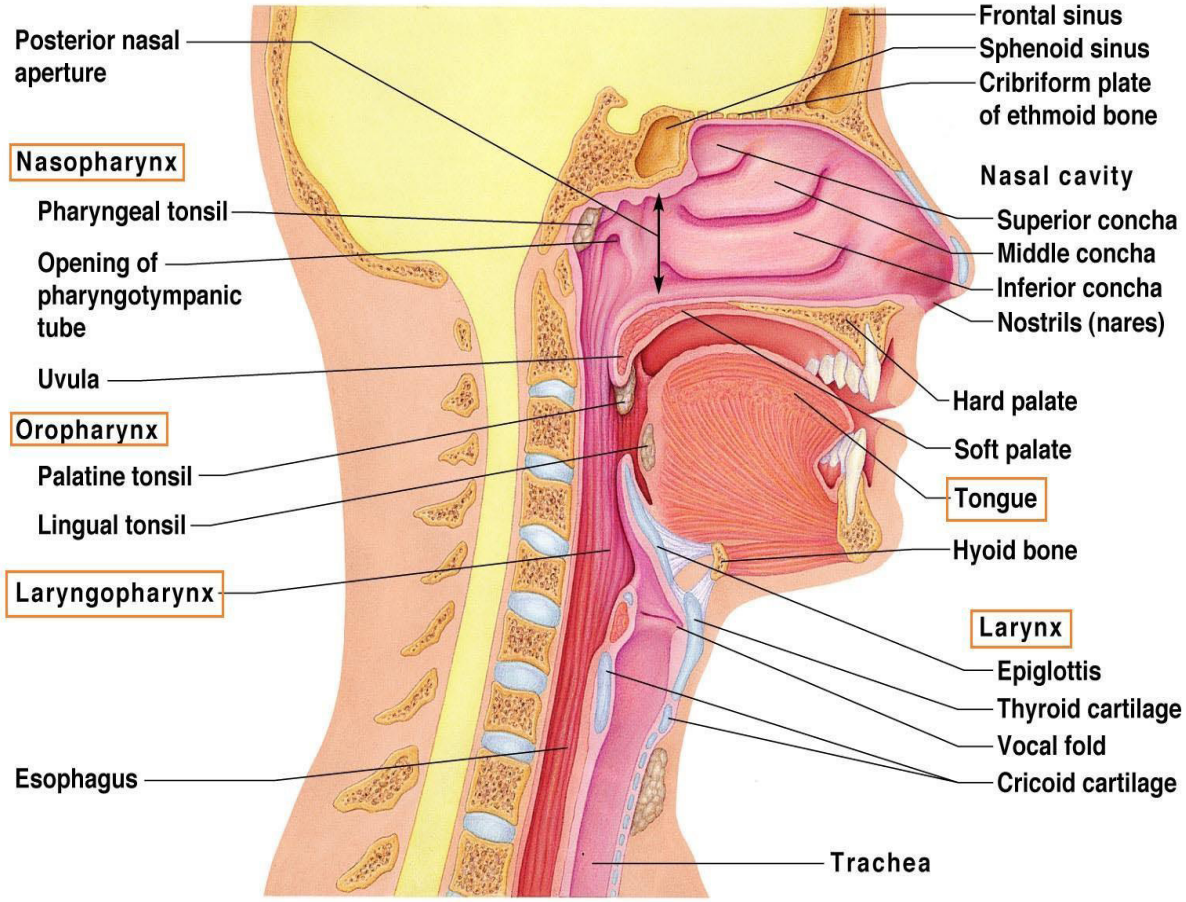
2) To help the anaesthesiologist in planning the airway management in difficult airway patients.

ANATOMY OF UPPER AIRWAY

The term airway means the upper airway i.e. the non respiratory portion of the airway.The following structures constitute the upper airway that include the nasal cavity,oral cavity,pharynx,larynx,trachea and large bronchi.The normal airway in the awake state and in healthy performs a various functions like filtration of ambient air,air conditioning, humidification and transport of air to and from the lungs for gaseous exchange between pulmonary alveoli and capillaries.(21,26)

The airway is not in active state during the period of induction and maintenance of general anesthesia due to the suppression of respiratory functions. The anesthesiologist should ventilate the patient by bag and mask,laryngeal mask airway or endotracheal tube.The anaesthesiologist should know well about the airway anatomy,its application and various methods of assessment of the airway,which will guide the anaesthesiologist to predict the factors causing difficulty in mask ventilation,laryngoscopy so that the airway management plan can be formulated.

Fig 1. ANATOMY OF UPPER AIRWAY



MOUTH

Mouth is made up of two parts.They are the vestibule and the oral cavity. Both of these structures communicate with each other through the angle of mouth. The vestibule is formed by the lips, cheeks, gums and teeth. The oral cavity is bounded in front by the alveolar arch and teeth.It is bounded superiorly by the palates,inferiorly by the anterior part of tongue and posteriorly by the oropharynx.

THE PALATE

Hard palate : is made up of the following two bones.

a) Palatine processes of maxilla

b) Horizontal plates of the palatine bones. (21,26)

Soft palate : Continues from the posterior border of the hard palate.In its central free part it has Uvula.It continues on each side with the pharyngeal wall. There are five muscles namely,

Tensor veli palatini, Levator veli palatini, Palatoglossus, Palatopharyngeus, Muscular uvulae.

These help to close the nasopharynx from the mouth during swallowing and speaking.

NOSE

Ellis et al (2004) in his work,"Anatomy for anaesthetist" has described that the nose is divided into the external nose and the nasal cavity.He described that the external nose is made of nasal bones,the nasal part of frontal bone and the frontal processes of maxillae,cartilages in the lower part.

The nose consists of the following parts,Choanae - posterior nasal opening and nasal cavity consisting of roof,floor,medial wall and lateral wall.

Blood supply: Arterial supply is by the anterior ethmoidal artery,posterior ethmoidal artery,maxillary artery,superior labial artery.The venous drainage occurs through the sphenopalatine,facial and ophthalmic veins.

Nerve supply : The olfactory nerve and trigeminal nerve.

The nasal cavity is subdivided by the nasal septum into two separate compartments that open to the exterior by the nares and into the nasopharynx by choana.(21,26)

PHARYNX

The pharynx forms a common pathway of respiratory and alimentary tracts. It has three parts namely nasopharynx,oropharynx and laryngopharynx.

Nasopharynx : The nasopharynx lies behind the nasal cavity and the soft palate.It communicates with the oropharynx through the pharyngeal isthmus. eustachian tube,adenoids,fossa of Rossenmuller are the important structures present in nasopharynx.

Oropharynx : Extends from oral cavity to tip of epiglottis as described by Ellis in " Anatomy for Anaesthetist".Palatine tonsils are the noteworthy structure present here.

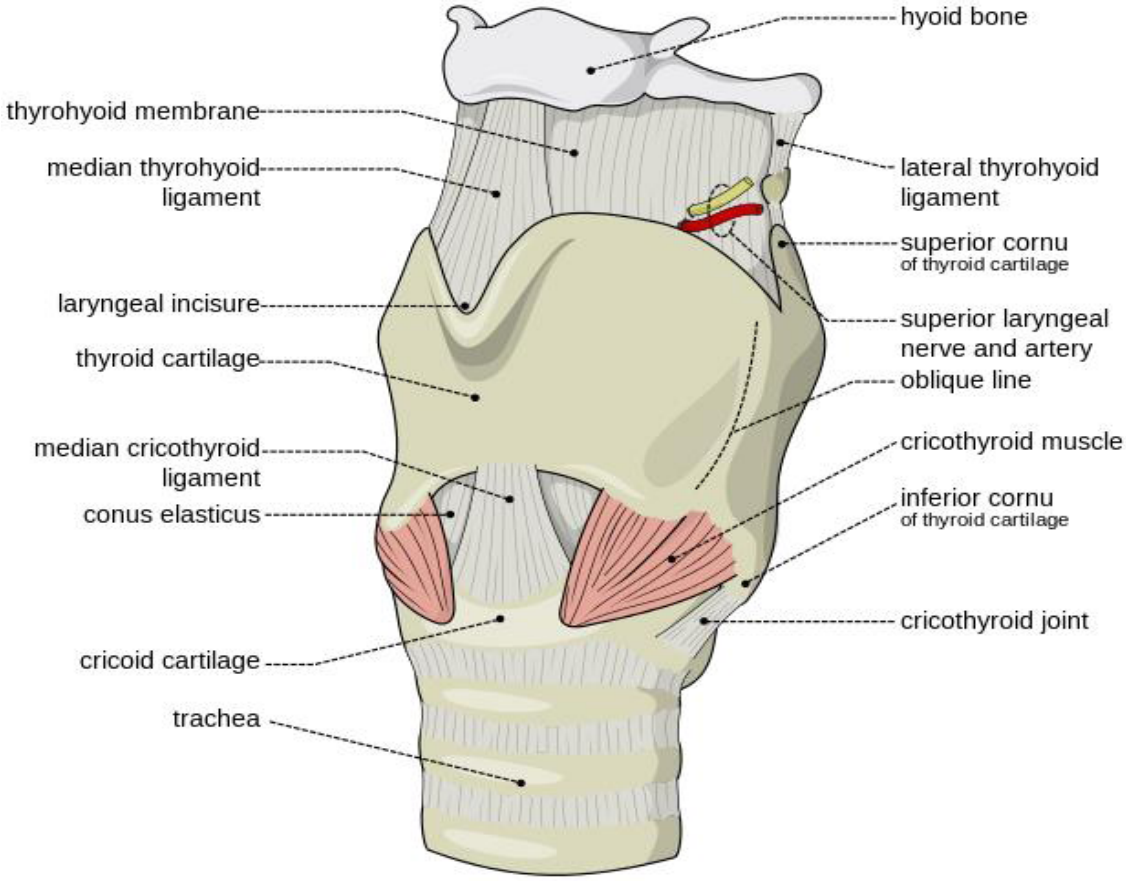
Laryngopharynx : Extends from tip of epiglottis to C6 level.It contains pyriform fossa.

The muscles of the pharynx : The muscles of the pharynx are superior, middle and inferior constrictors,the stylopharyngeus,salpingopharyngeus and palatopharyngeus.

LARYNX

Larynx is situated anterior to the bodies of C4, C5, C6 vertebra and commands the entrance to the pulmonary system.It is a strong muscular organ that is primarily a valve of the respiratory tract.The development of larynx as organ of speech is much later and is popularly known as voice box. Structurally the larynx is in the form of a box composed of nine cartilages, connected by ligaments and moved by nine muscles.(21,26)

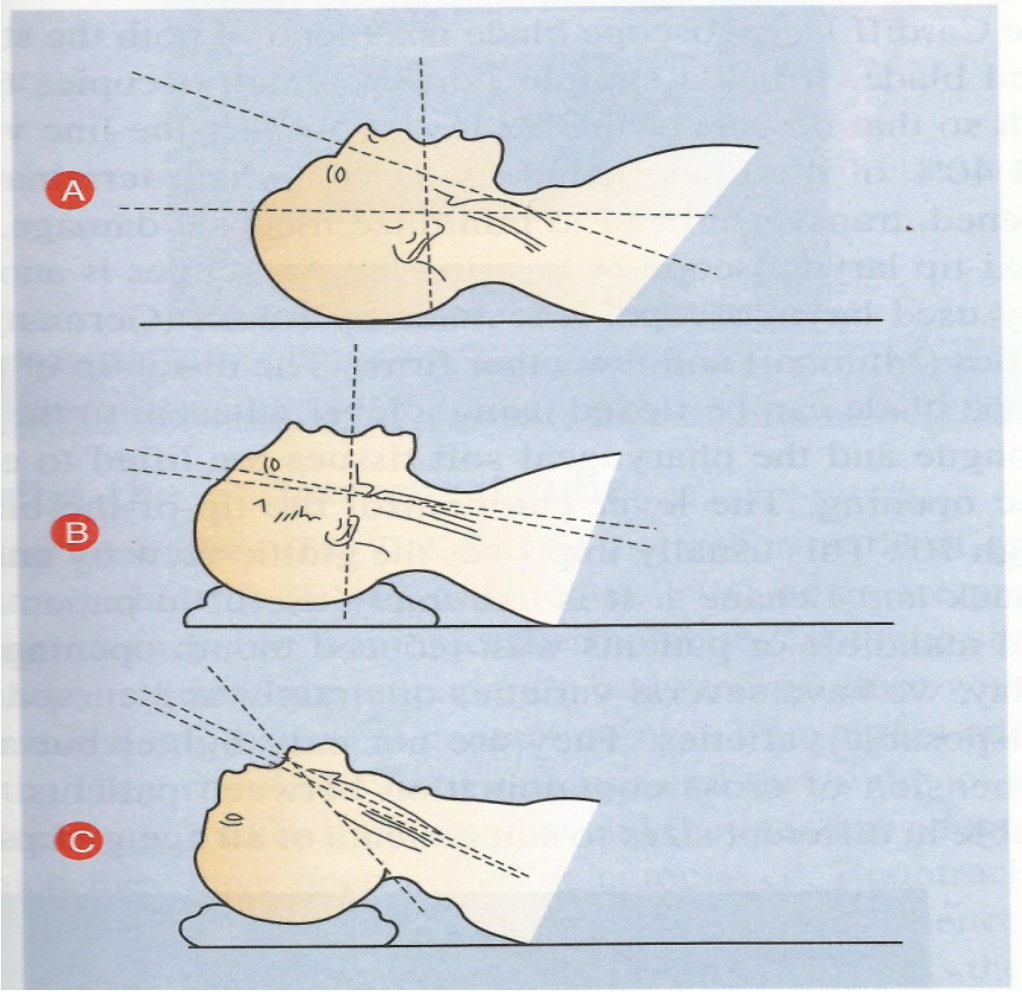
FIG2. THE LARYNX



Laryngoscopic anatomy of larynx

In order to view the glottic opening during direct laryngoscopy,the oral axis, pharyngeal axis and the laryngeal axis that normally lie in perpendicular plane to each other must be aligned such that they come to lie in the same plane.Elevation of the head about 10 cms with pillow under the occiput with shoulders remaining on the table aligns the laryngeal and pharyngeal axis. Flexion of the neck and extension at the atlanto-occipital joint creates almost a straight line from the incisor teeth to glottis opening this is termed the sniffing position.

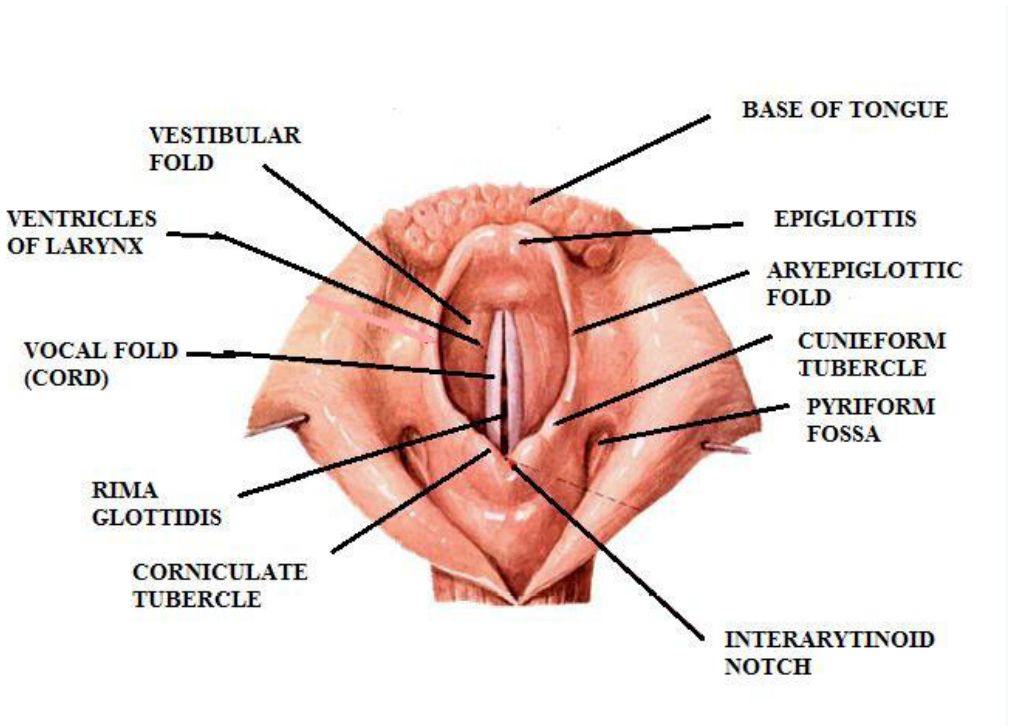
FIG3.HEAD POSITION FOR INTUBATION



The structures that are visualized as the laryngoscopic blade is passed through the oral cavity,in the order of appearance are base of the tongue,the valleculae,the anterior surface of the epiglottis and then the laryngeal opening.Thin fold of tissue are seen running from the epiglottis posteriorly. They are the aryepiglottic folds. They contain cuneiform and corniculate cartilages in their posterior end.

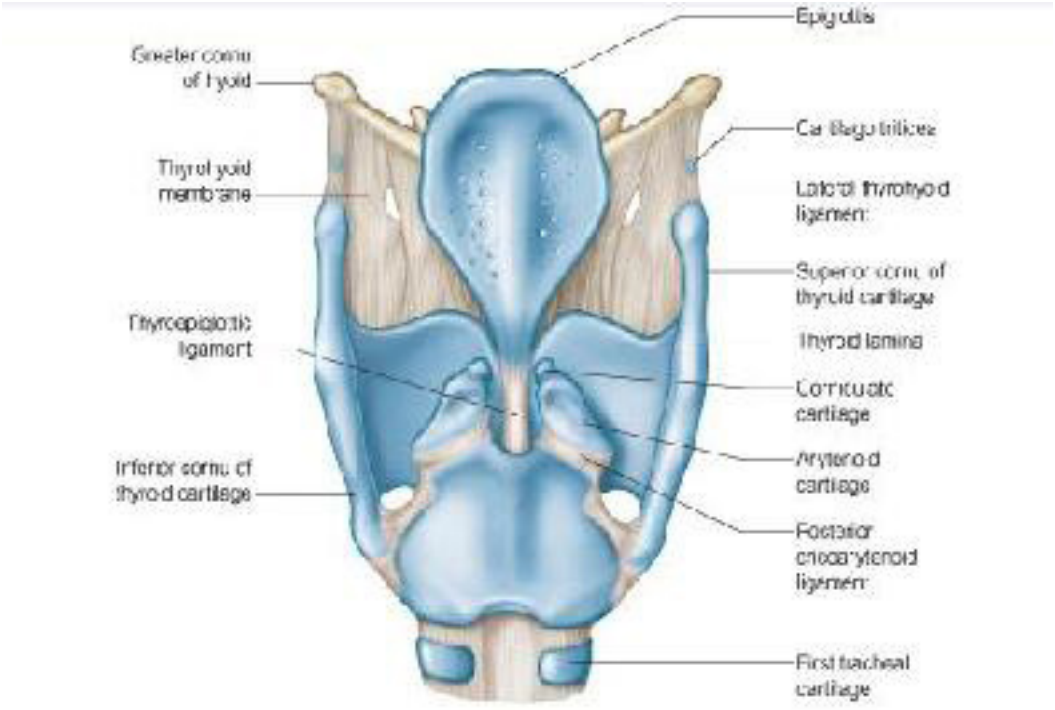
The vocal cords are seen as pale paired structures that are abducted as the patient is paralysed with a muscle relaxant prior to laryngoscopy.The opening in between vocal cords are called rima glottidis.Through this opening the tracheal rings can be seen.

Fig 4. DIRECT LARYNGOSCOPIC VIEW OF GLOTTIC OPENING



Laryngeal cartilages : The laryngeal cartilages comprise the single cricoid, thyroid and epiglottic cartilages and the paired arytenoid,cuneiform and corniculate cartilages.

5. CARTILAGES OF LARYNX



1. ARYTENOID CARTILAGES

These are pyramid shaped cartilages.They are present on the sides of cricoid cartilages.The posterior cricoarytenoid muscle and the lateral cricoarytenoid muscles are attached on the lateral aspect of the arytenoid cartilage.The vocal ligaments are attached to the anterior aspect.Corniculate cartilage are present medially.

2. CORNICULATE CARTILAGES

These are paired cartilages.Conical in shape.Attached to the medial end of the arytenoid cartilage.

3. CUNEIFORM CARTILAGES

They are paired cartilages present in relation to the corniculate cartilage.

4. CRICOID CARTILAGE

Cricoid cartilage can be regarded as the skeletal foundation of the larynx,attached below to the trachea and articulated by synovial joints to the thyroid cartilage and the two arytenoids.It is the only cartilage of larynx that is present as a complete ring.It forms the entire wall of the lower part of larynx.

Cricoid lamina : is quadrilateral in outline,2-3cm in vertical dimension.
Cricoid arch : Narrow anteriorly,broader posteriorly.

Cricotracheal ligament is attached on the lower side and cricothyroid ligament is attached on the upper side. (21,26)

5. THYROID CARTILAGE

The thyroid cartilage is an unpaired cartilage.It is the largest of laryngeal cartilages. It consists of Adam's apple,thyroid notch,superior cornua and inferior cornua.Thyrohyoid membrane is attached to the superior cornua.

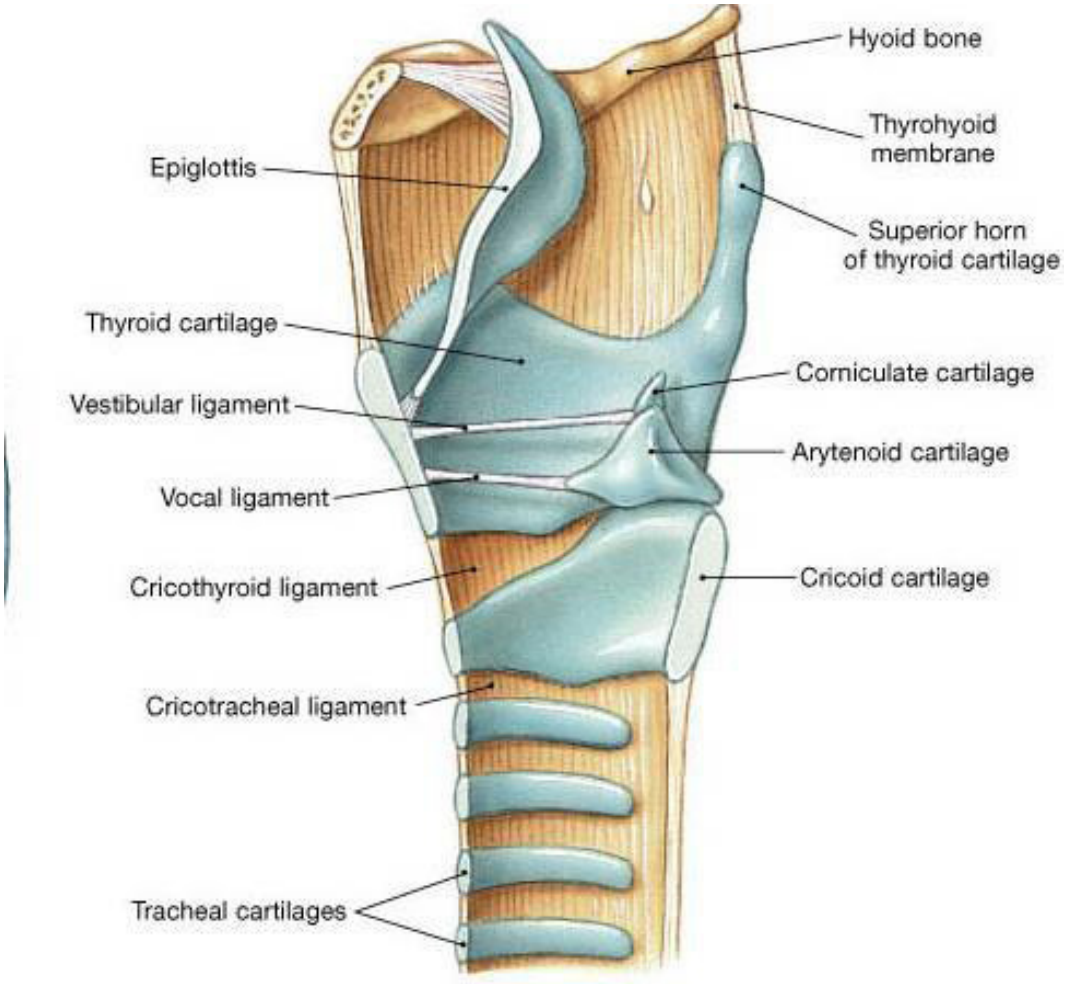
6. EPIGLOTTIC CARTILAGE

The epiglottic cartilage is a fibroelastic cartilage.It is leaf shaped.Its upper end is free and lower end is attached to thyroid notch.It's sides are attached to the arytenoid cartilages by aryepiglottic folds.The median depression is called Vallecula.Epiglottic tubercle is seen in the posterior part.

Laryngeal ligaments

The ligaments of the larynx is divided into extrinsic ligaments and intrinsic ligaments.

Fig 6. LIGAMENTS OF LARYNX



EXTRINSIC

1. THYROHYOID MEMBRANE

It is a broad fibroelastic membrane attached below to the superior border of the lamina of thyroid cartilage and its superior cornua and above to the superior margin of the body of hyoid bone and greater cornua.Its thicker part is the median thyrohyoid ligament and thinner lateral part is the lateral thyrohyoid ligament.The membrane is pierced by internal branch of superior laryngeal nerve and superior laryngeal vessels.

2. CRICOTRACHEAL LIGAMENT

It unites the lower cricoid border to the first tracheal cartilage.

3. HYOEPIGLOTTIC LIGAMENT

It connects the epiglottis to the back of the body of hyoid.

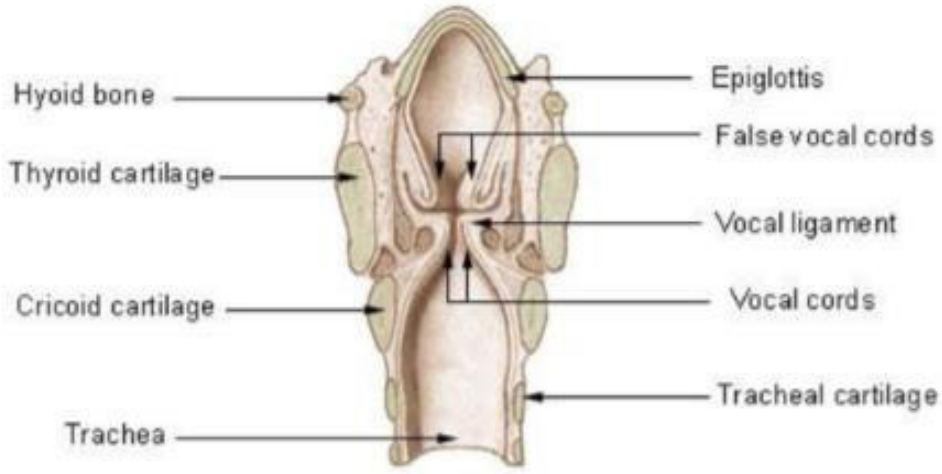
4. CRICOTHYROID LIGAMENT

It comprises the inferior larger part of laryngeal membrane and is comprised of anterior and lateral parts.The single thick anterior (median) cricothyroid ligament is broad below and narrow above.It connects adjacent margins of cricoid and thyroid cartilages.An anastomoses between the cricothyroid arteries crosses it and supply perforating branches to the larynx.The paired smaller lateral cricothyroid ligaments are thinner.

Laryngeal cavity

The laryngeal cavity space extends from the laryngeal inlet, from the pharynx, down to the lower border of cricoid cartilage where it continues into the trachea.It is partially divided into upper and lower parts by paired upper and lower mucosal folds,with a middle part between the two sets of folds

Fig 7 . CAVITY OF LARYNX



Upper folds are vestibular folds,median aperture that they guard is Rima vestibuli and the lower pair are vocal folds and the fissure between the latter are Rima glottidis or glottis.

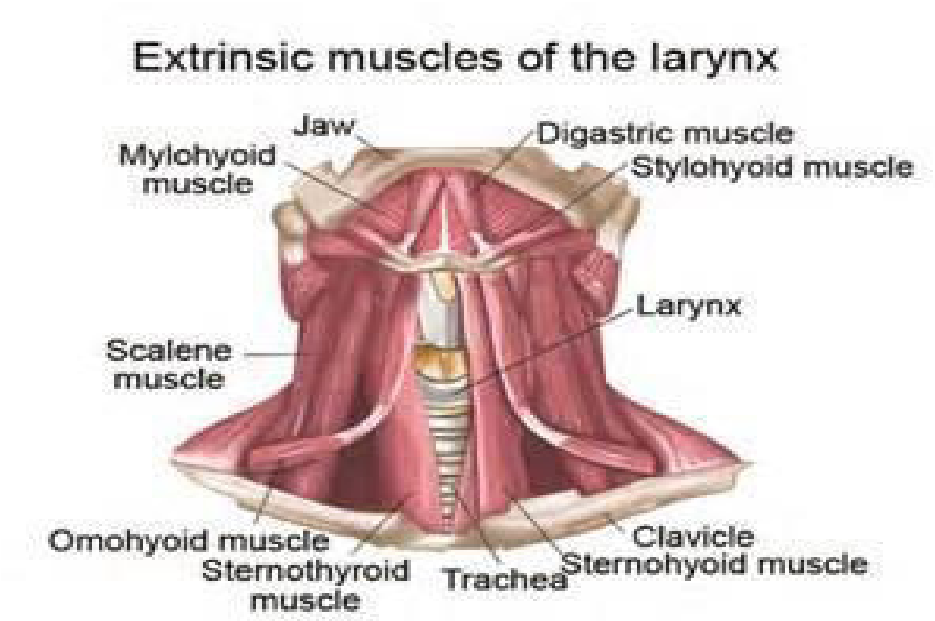
The muscles of the larynx

There are two groups of muscles in larynx,Extrinsic group and Intrinsic group.

The extrinsic muscles are

Sternothyroid,Thyrohyoid,Stylopharyngeus,Palatopharyngeus

Fig 8. EXTRINSIC MUSCLES OF THE LARYNX

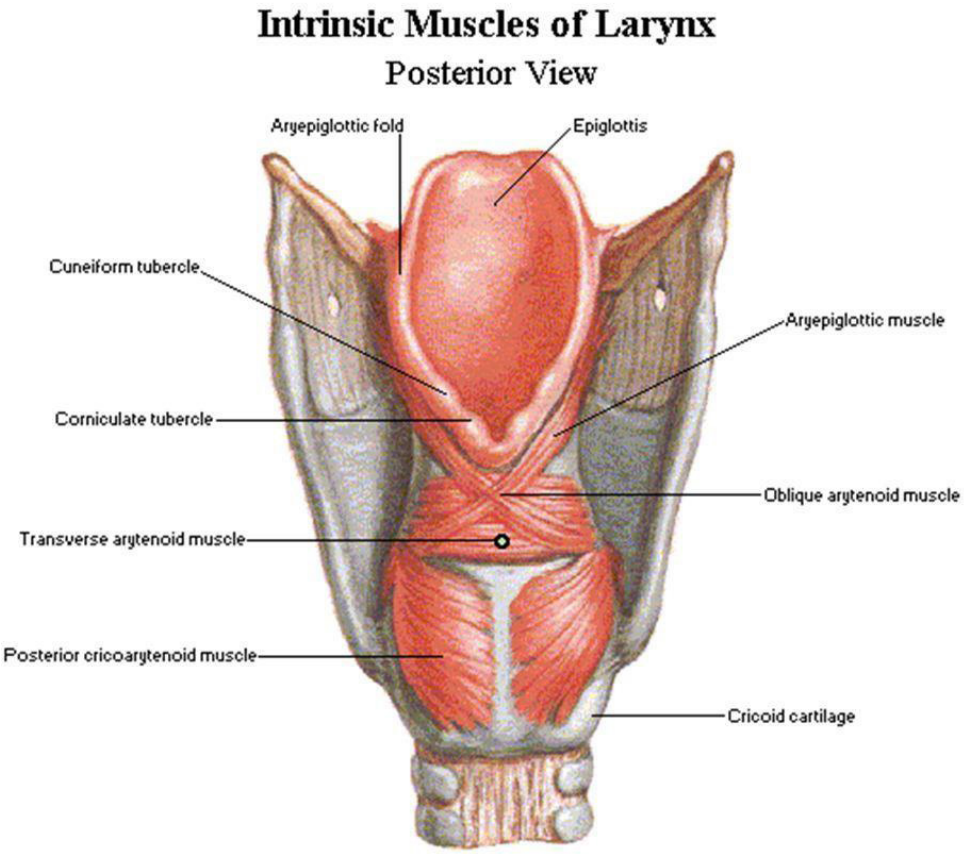


The *intrinsic muscles of the larynx* function in,Opening,closing and tensors of the cords.

The Intrinsic muscles are

Lateral Cricoarytenoids, Posterior Cricoarytenoids, Interarytenoids, Aryepiglottic, Thyroarytenoid,Vocalis,Cricothyroid

Fig 9. INTRINSIC MUSCLES OF THE LARYNX



Nerve supply:

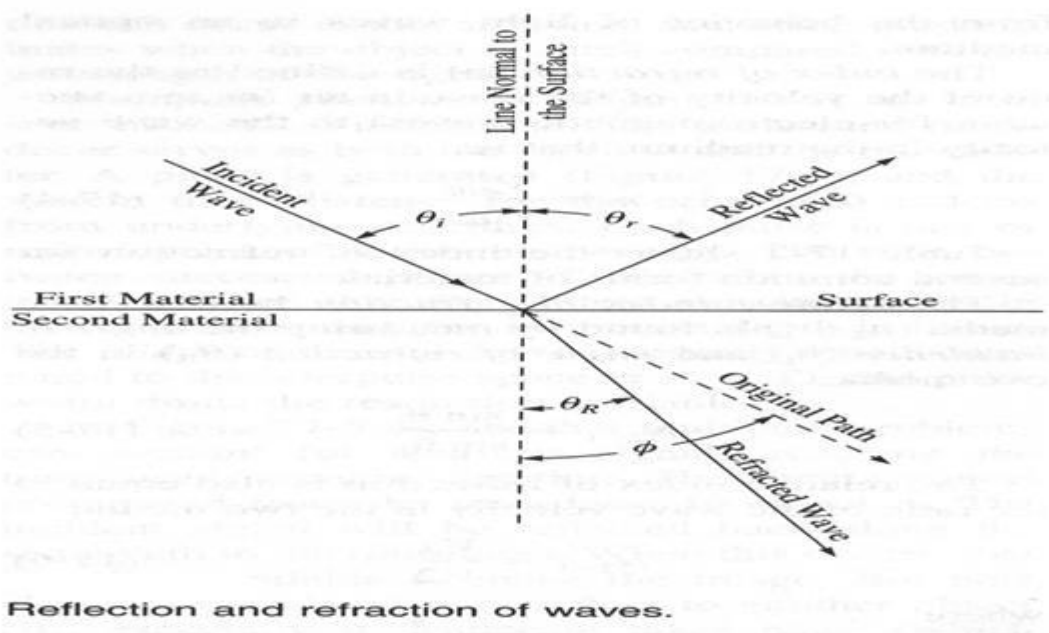
The recurrent laryngeal nerve supplies all the muscles of larynx which moves the vocal cords,but external laryngeal nerve which is the branch of superior laryngeal nerve supplies cricothyroid muscle.Sensory supply of larynx above the vocal cord is supplied by internal laryngeal nerve which is the branch of superior laryngeal nerve and below the vocal cord is supplied by recurrent laryngeal nerve.

THE ULTRASOUND MACHINE

Principle of Ultrasound :

Ultrasound uses sound waves to produce images of structure through which they pass.The sound waves pass through tissues as alternating pressure waveforms.The low pressure wave is called rarefaction and high pressure wave is called compression. (28)

Fig 10. REFLECTION AND REFRACTION OF WAVES

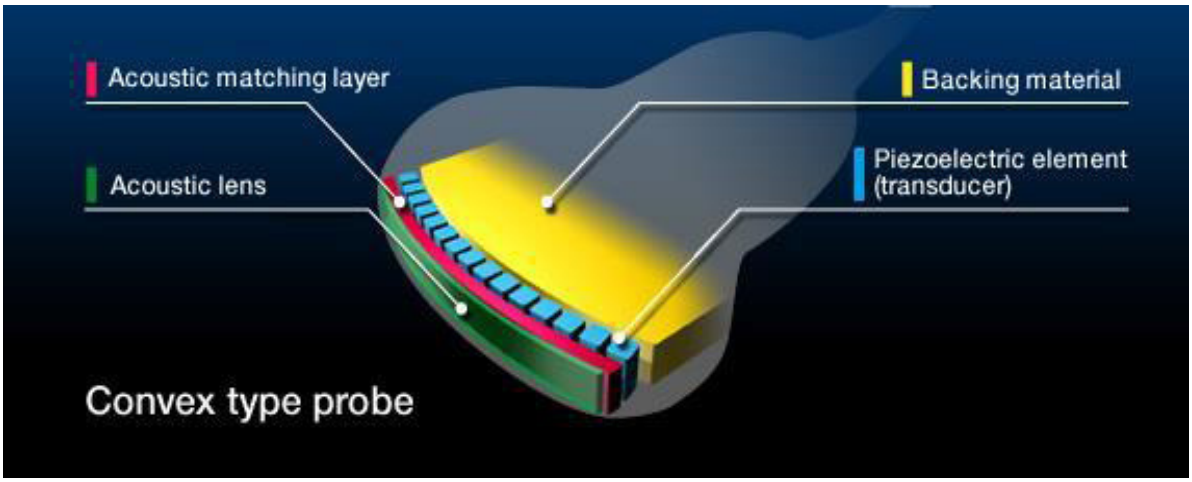


Reflection and refraction of waves.

Human hearing is in the range of 20-20000HZ.The frequency of the waves transmitted by ultrasound machine are above 20000HZ.

Generation of an ultrasound wave

Fig 11. ULTRASOUND TRANSDUCER WITH PIEZOELECTRIC CRYSTAL



An ultrasound wave is generated when an electric field is applied to an array of piezoelectric crystals located on the transducer surface.Electrical stimulation causes mechanical distortion of the crystals resulting in vibration and production of sound waves.The conversion of electrical to mechanical energy is called the converse piezoelectric effect

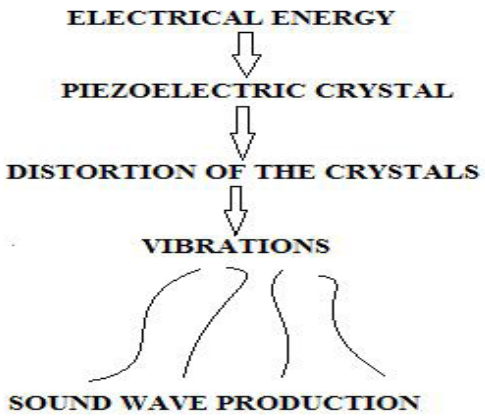
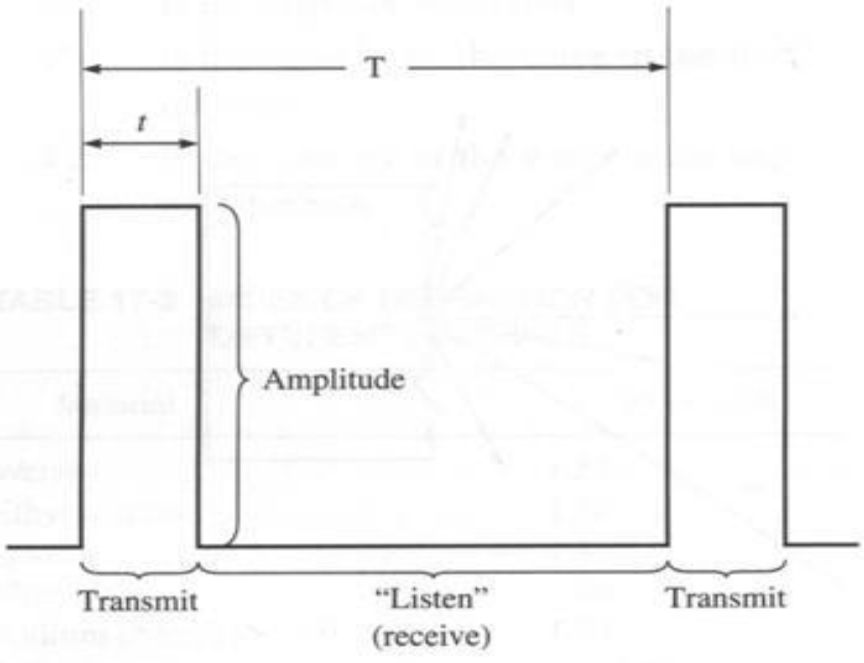


Fig 12. GENERATION OF ULTRASOUND IMAGE



Ultrasound system transmits and then listens for pulse.

The ultrasound transducer transmits the sound waves and waits to receive back the returning sound waves before transmitting the next wave. The sound waves that were transmitted from the transducer,travel through the body tissues and then get reflected.These reflected waves return back to the transducer probe and are received by it.This is then converted back to the electrical energy.This effect is called as Piezoelectric effect. (28,29)

This electrical energy is converted by the machine computer to images that are displayed.

As the sound waves pass through the body tissues they undergo the following,

Reflection ,

Rarefaction ,

Diffraction that bending of waves on hitting a different density medium,

Scattering ,

Acoustic impedence that is opposition to the sound waves.

There are 3 modes in ultrasound

1) Amplitude (A) Mode

2) Brightness (B) Mode

3) Motion (M) Mode.

There are 5 basic components of an ultrasound scanner that are required for generation, display and storage of an ultrasound image.(29,30,31)

1.Pulser - applies high amplitude voltage to energize the crystals.

2.Transducer - converts electrical energy to mechanical (ultrasound) energy and vice versa.

3.Receiver - detects and amplifies weak signals.

4.Display - displays ultrasound signals in a variety of modes.

5.Memory - stores video display and images.

Selecting a transducer probe

Fig 13. TYPES OF ULTRASOUND TRANSDUCER

There are three main properties based on which the transducer is selected.

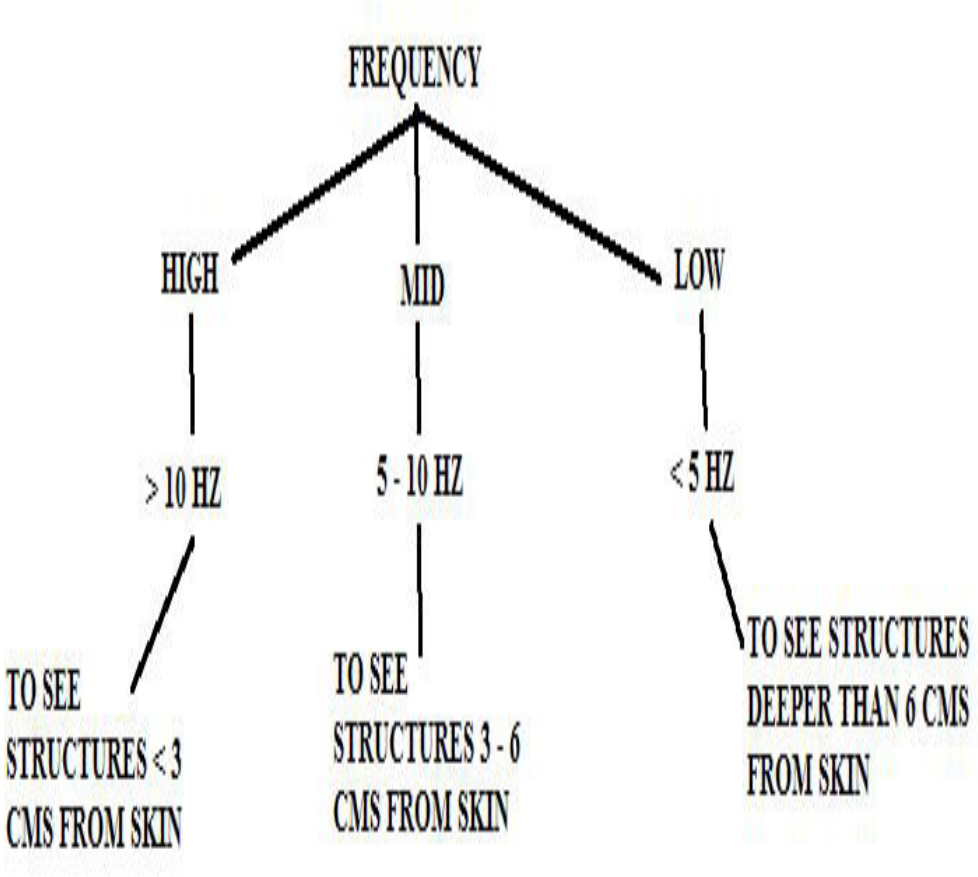
They are

1) Frequency

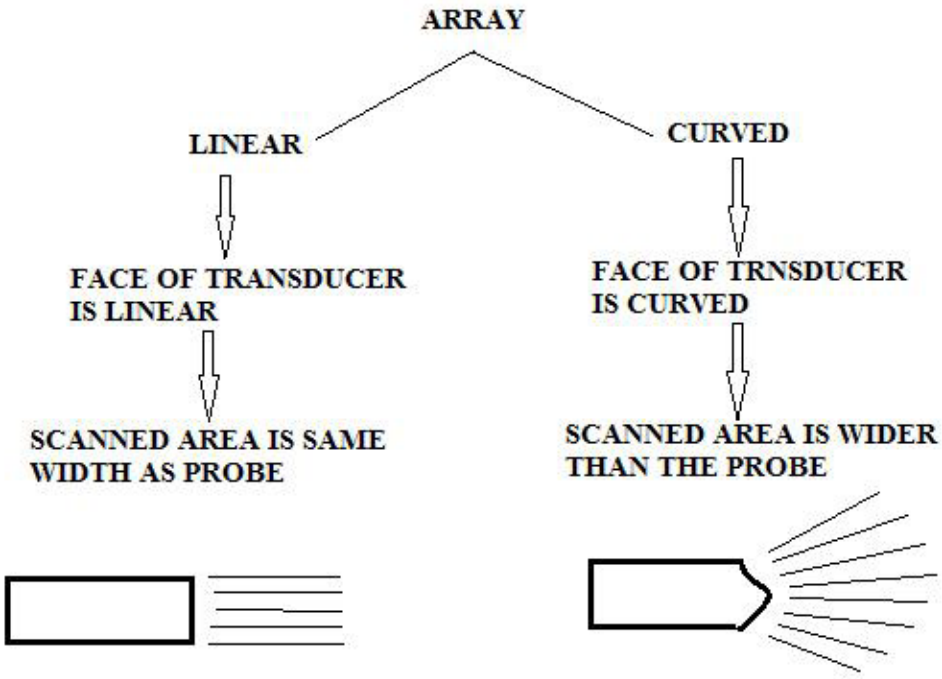
2) Array configuration

3) Foot print - It is the diameter of the probe..

Based on frequency the transducers are classified as follows,(29,30,31)



Based on array configuration the transducers are classified as follows,



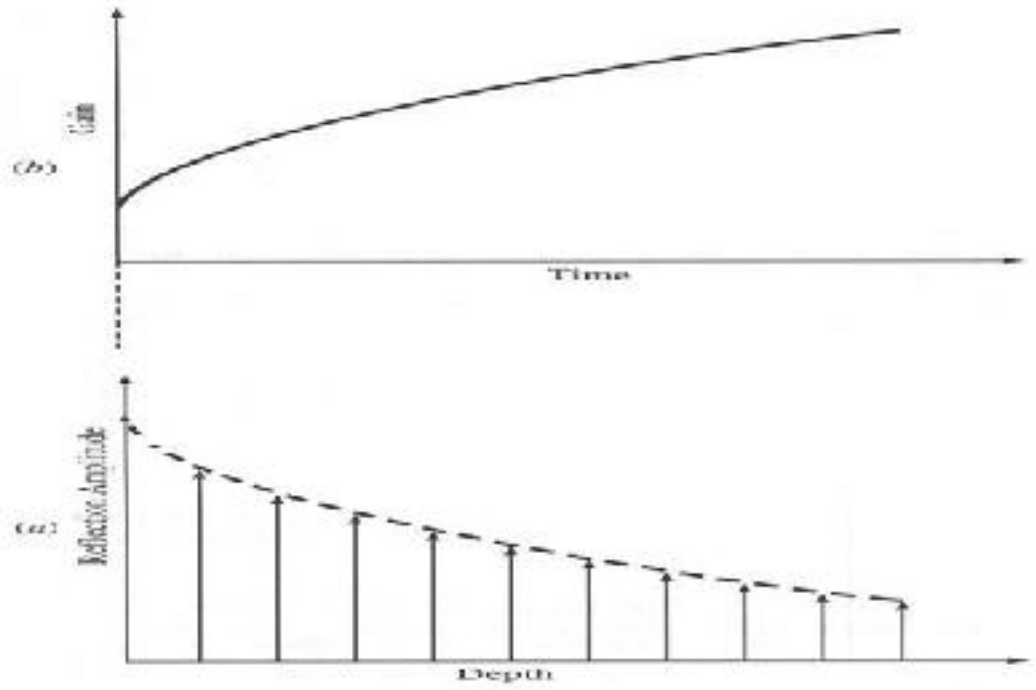
Enhancement and Attenuation

Structures that are originally deeper appear brighter than expected for that depth.This is because more sound waves have passed to the structure than expected as the other tissues surrounding the structure absorbed more sound waves.This phenomenon is called Enhancement.(29,30,31)

The opposite effect where superficial structures appear dark because of reduced passage of sound waves to it due to increased impedence is called Attenuation.

CONTROLS IN THE MACHINE

Fig 14. TIME GAIN COMPENSATION CURVE



(a) Deeper targets return weaker signals. *(b)* Time-gain compensation curve.

- Gain – amplification of returning echoes (Overall brightness)
- Time gain compensation (curve) :Adjust brightness at different depths
- Freeze
- Depth :Zoom in superficial, or zoom out for wide view. Depth limited by frequency
- Focal zone :Optimal resolution wherever focal zone is. (29, 30, 31)

ULTRASOUND ANATOMY OF AIRWAY

Kristensen et al (2013)has stated that the linear high-frequency transducer is most suitable for imaging superficial airway structures (within 2–3 cm from the skin) and that the curved low-frequency transducer,is most suitable for obtaining sagittal and parasagittal views of structures in the submandibular and supraglottic regions,mainly because of its wider field of view.(31,32)

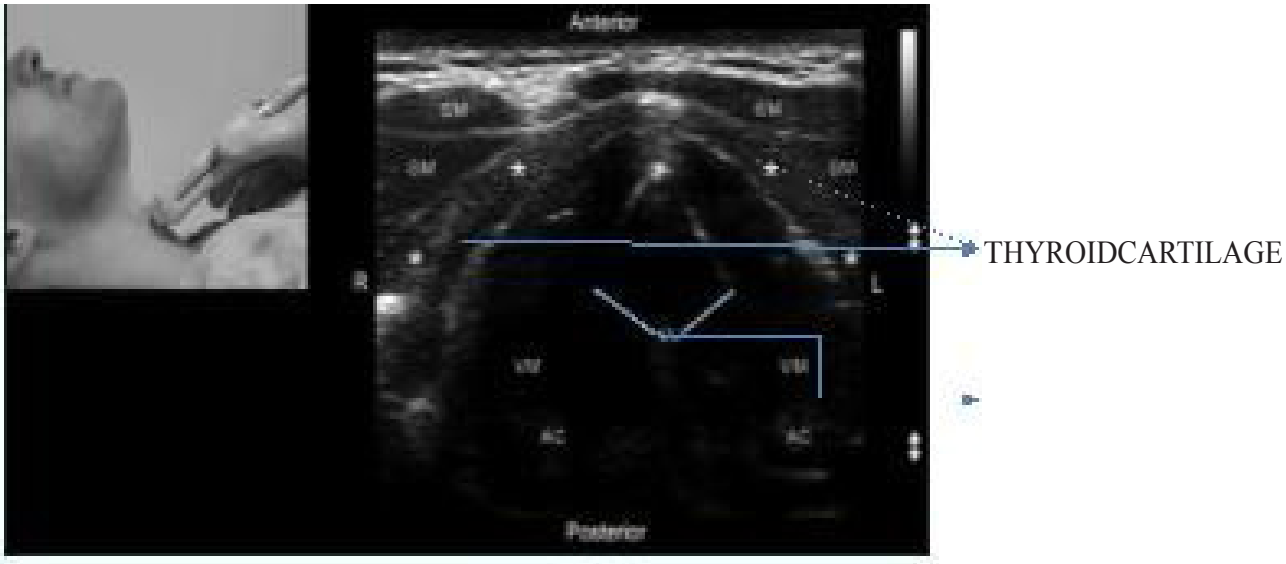
Ultrasonogram appearances of upper airway structures are as follows,

Bones	Mentum	Linear hyperechoic with acoustic shadow
	Mandible	Linear hyperechoic with acoustic shadow
	Hyoid	Linear hyperechoic with acoustic shadow
	Sternum	Linear hyperechoic with acoustic shadow
Cartilages	Thyroid	Homogenously hypoechoic
	Cricoid	Homogenously hypoechoic
Muscles		Hypoechoic Heterogenous striated
Tissue membranes		Hypoechoic Heterogenous striated
Glands	Sub - mandibular	Homogenous hyperechoic
	Thyroid	Homogenous hyperechoic

Any interface between the mucosa lining the upper airway tract and the air within it (an air-mucosa [A-M] interface) has a bright hyperechoic linear appearance.In an air- filled space deep to an A-M interface,air artifacts such as comet tail and reverberation artifacts could be visualized.(31,32)

- **Vocal Cords**

Fig 15. VOCAL CORDS IN TRANSVERSE VIEW

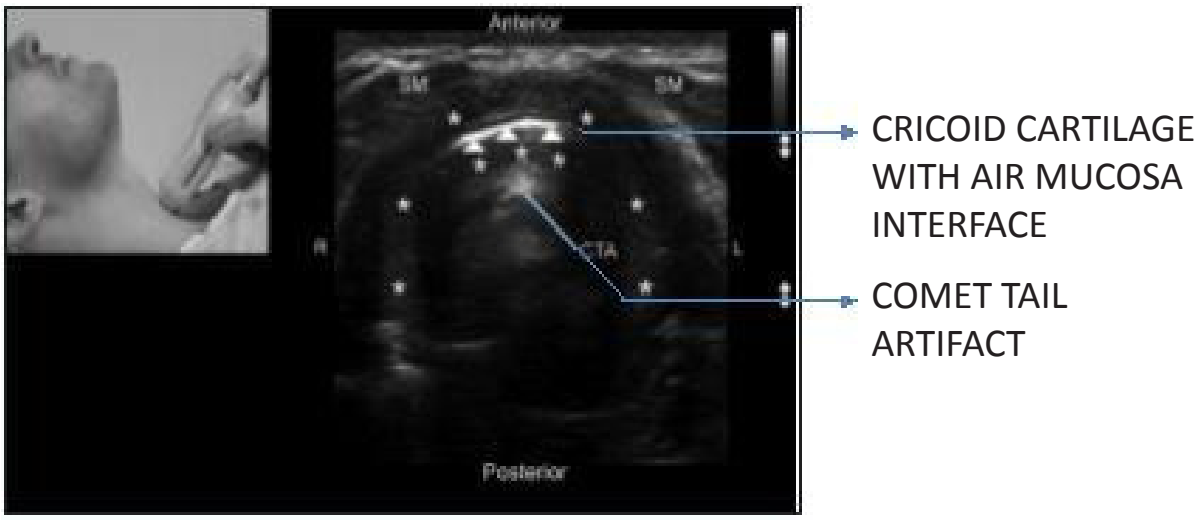


The vocal cords are seen in a transverse plane and placed at 3 separate locations: (1)the thyrohyoid membrane;(2)the thyroid cartilage; and (3)the cricothyroid membrane.The true cords are hypoechoic,outlined by the hyperechoic vocal ligament.They are triangular in shape.The false vocal cords lay parallel and cephalad to the true cords and are more hyperechoic in appearance.The true and false cords can be further distinguished during phonation (“aa-aa” and “ee-ee”

words): the true cords will be observed to oscillate and move toward the midline compared with the false cords,which will remain relatively immobile .(31,32)

- **Cricoid Cartilage and Cricothyroid Membrane**

Fig 16. CRICOID CARTILAGE AND CRICOTHYROID MEMBRANE



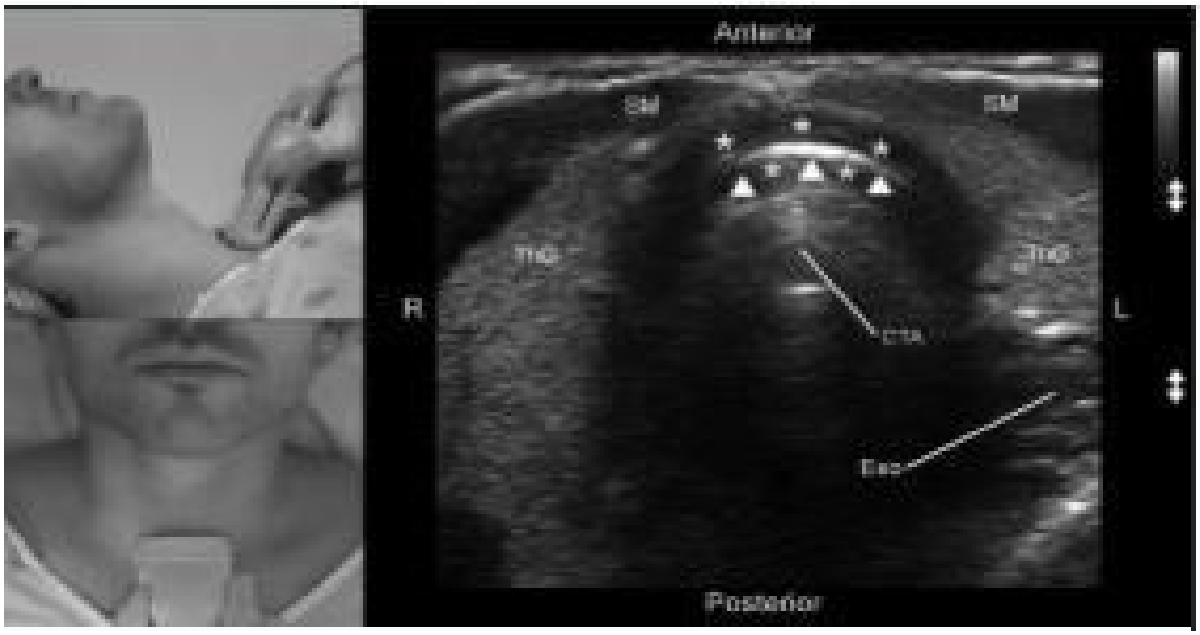
Parasagittal plane : Round hypoechoic

Transverse plane : Arch shaped.

The posterior surface of its anterior wall is delineated by a bright A-M interface as well as reverberation artifacts from intraluminal air.

- **Trachea and Neighbouring Structures**

Fig 17. SUPRASTERNAL NOTCH LEVEL WITH TRACHEA , AIR MUCOSA INTERFACE AND COMET TAIL APPEARANCE



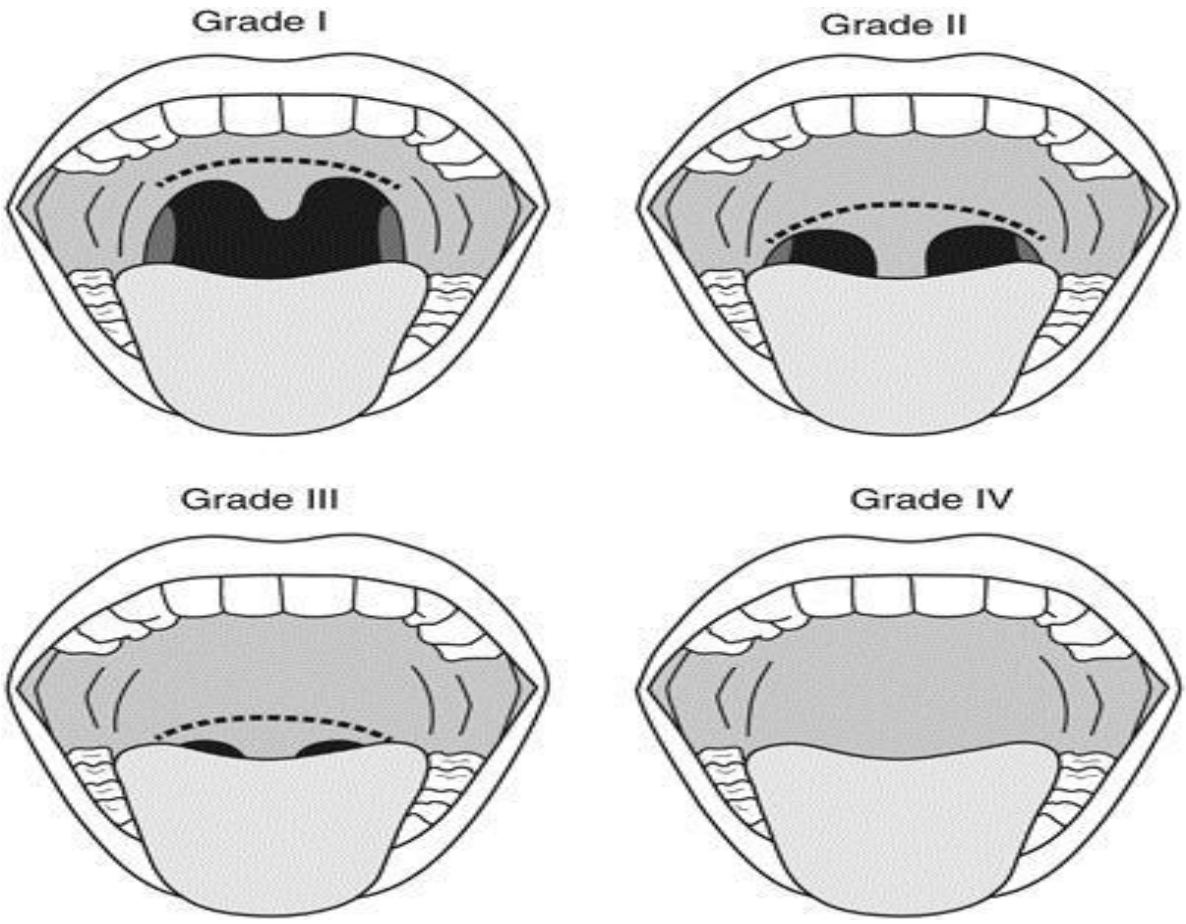
As in other cartilaginous structures, the tracheal rings are hypoechoic.On the parasagittal and sagittal views,they resemble a “string of beads,”and on the transverse view,they resemble an inverted U highlighted by a linear hyperechoic A-M interface and reverberation artifact posteriorly.The 2 lobes and isthmus of the thyroid gland are visualized anterolateral to the trachea on the transverse view at suprasternal notch level.The thyroid gland is homogeneously hyperechoic with a finely speckled appearance. (31,32)

ANATOMICAL PREDICTORS OF DIFFICULT AIRWAY

1. Mallampatti's test :

The Mallampatti's classification gives us the relationship between the size of the tongue and the size of the pharynx.The patient is seated, head held in neutral position, mouth open as wide as possible and tongue protruded out maximum. Patient should be instructed not to speak.Classification is done based on the structures that are visible. (7,9)

Fig 18. MALLAMPATI CLASSIFICATION



Mallampatti' s I : Soft palate, fauces, uvula, anterior and posterior pillars

Mallampatti's II : Soft palate, fauces and uvula are seen.

Mallampatti's III : Soft palate and base of uvula alone are seen.

In Samson and Young's modification (1987) of the Mallampatti's classification,a IV class was added. (7,10)

Mallampatti's IV : Only hard palate seen.

Atlanto occipital joint extension:

Ability to maintain Sniffing or Magill position for intubation is assessed by this test.The patient is asked to hold head erect,facing directly to the front,then he is asked to extend the head maximally and the examiner estimates the angle traversed by the occlusal surface of upper teeth.Measurement can be by simple visual estimate or more accurately with a goniometer.Any reduction in extension is expressed in grades:

Grade I : >35°

Grade II : 22°-34°

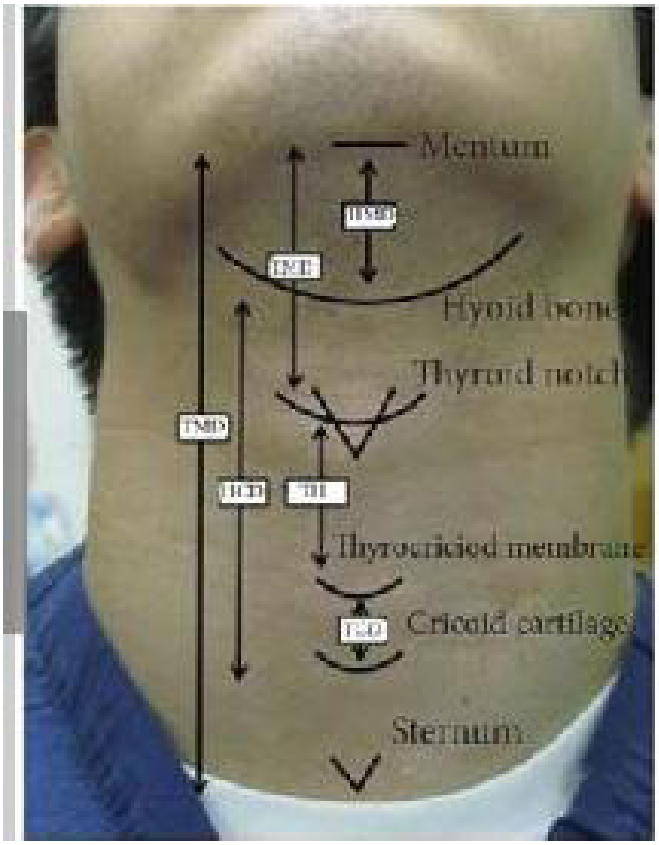
Grade III : 12°-21°

Grade IV : < 12°

Normal angle of extension is 35° or more.

Mandibular space

Fig 19. MANDIBULAR SPACE



HMD - HYOMENTAL DISTANCE

TMD – THYRO MENTAL DISTANCE

TH - THYROHYOID

TCD - THYRO CRICOID DISTANCE

HCD - HYOCRICOID DISTANCE

SMD - STERNOMENTAL DISTANCE

Thyromental (T-M) distance (Patil's test):

Thyromental distance as the name suggests is the distance between the thyroid notch and tip of mentum.It is measured after asking the patient to keep the neck fully extended.Thyromental distance gives a rough idea of the relation between larynx and pharynx.It gives us information regarding the alignment of each other when the neck is placed in the intubating position.

Difficult intubation - distance is < 6 cm in adults;

Less difficult intubation- 6 - 6.5 cms

Easy intubation - > 6.5 cm

Sterno-mental distance :

Sterno mental distance is the distance between suprasternal notch and tip of mentum.It is measured after asking the patient to keep the neck fully extended.

Sterno mental distance < 12cms - intubation difficult.(8)

Mandibulo-hyoid distance :

Distance from tip of mandible to hyoid bone is called mandibulo hyoid distance.If the distance is increased then intubation is difficult. Normal is <4 cms.

Inter-incisor distance :

The vertical distance from upper incisors to lower incisors.

Normal is > 4 cm.

<4 cm - difficult airway.

REVIEW OF LITERATURE

1) **Tanck et al .** conducted a study to develop a multivariate analyzing factors for stratifying the risk of difficulty in intubation.They evaluated 10,507 patients prior before anaesthesia with variable parameters like thyromental distance,neck movements,mouth opening,body weight,able to prognath the mandible and any other previous history of documented difficult airway.After patient induced with anaesthesia factors like ability to mask ventilate the patient and Cormack-lehane grading were recorded.They concluded that the difficult airway as graded by Cormack –Lehane grading during direct laryngoscopy can be assessed by means of only by preoperative multivariate risk index.

2) Delanoue et al predicted that intubation was found to be difficult in patients with obesity by evaluation of intubation difficulty scale.They did their study in 70 obese and 61 lean patients to assess the airway by using bedside tests and neck circumference.Preoperatively thyromental distance,sternomental distance,inter incisor distance,body mass index and neck circumference were recorded.The IDS was recorded.They concluded that in patients with intubation difficulty scale >5,modified mallampatti score>2,neck circumference>40 cm,thyromental distance<6cm were the preoperative checkmarkers for difficult laryngoscopy and intubation.

3) Arun Prasad govindarajulu etal conducted a study to evaluate the use of ultrasound in analyzing the anterior neck soft tissue structures to find out the structural anatomy of airway and the factors which can be measured that may help in airway assessment.The study was conducted in 30 patients who underwent elective surgery and intubation .The parameters in ultrasound assessment were epiglottis,angulation of epiglottis,epiglottis depth,arytenoids depth,thyrohyoid distance,thickness of tongue.The Cormack-Lehane grading and intubation difficulty score were recorded.The most valuable parameters in this study was the epiglottis angle.Further studies will be conducted to find out the credibility of the parameters in assessing difficult airway. (5)

4) Brodsky et al conducted a study 100 patients whose body mass index was more than 40.Intubation of trachea in obese patients may be difficult than in lean patients.Pre operatively these patient's various parameters like (weight,height,thyromental distance,inter incisor distance,sternomental distance) were recorded.The Cormack –Lehane grading and intubation attempts were noted. They concluded that obesity alone was not predictive of difficult laryngoscopy and intubation.Neck circumference>40 cm,modified mallampatti class>2 were associated with difficult airway.

5) Sengupta et al conducted a study to findout the association between morbid obesity and difficulty laryngoscopy and intubation.They analysed the

use of ultrasound to quantify the neck soft tissue in 64 obese patients.They assessed various parameters like age,race,gender,limited neckmobility,modified mallampatti classification,neck circumference,body mass index,thyromental distance.In this study the patients classified as having difficult laryngoscopy were found to have less amount of pretracheal soft tissue.They concluded that no single factor independently predicts difficult laryngoscopy. (25)

6) Oliver fourcade etal Neck circumference alone is a sensitive test meaning that neck circumference<43 cm tracheal intubation will be uneventful. In combination with Modified Mallampatti's score it becomes more specific it meant that when Mallampatti>3 and Neck circumference >43 trachel intubation will be difficult.Although not a perfect predictor of difficult intubation,neck circumference is a useful and easily performed bedside test that will be useful for the anaesthesiologist in the matter of airway assessment.

7) Mandeep singh et al ; 2009 conducted a study to evaluate the usefulness of ultrasonogram for identifying the structures in the upper airway.Their sample size was 24.They placed the patient in sniffing position and conducted the study. They were able to identify all the structures in all the patients.They used both linear and curved probe.They studied the anatomy in three planes namely 1)sagittal 2)parasagittal 3)transverse.Bones were seen as bright hyperechoic followed by hypoechoic shadow.The other structure that was seen was the vocal cords.They

were not able to visualize the posterior parts of pharynx and trachea because of air column.They concluded that sonography of airway is useful in identifying the structures.

8) Jacek A.Wojtczak et al ; 2011 conducted a study in obese patients, whose neck circumference was large.They used ultrasonogram to measure the size of tongue and hyomental distance ratio.The sample size was 12.Out of the 12,5 were obese and 7 were moderately obese.Patients were positioned first in supine position with neutral position of head.Hyomental distance was taken first in this position.Then the patient was asked to extend the neck to the maximum.The second measurement of hyomental distance was taken in this position.The ratio between the two distance was calculated.This ratio was taken as the hyomental distance.The size of the tongue was calculated.It was the product of area and width of the tongue.They found that,ultrasonogram can be used to measure the hyomental distance ratio.It was also useful in measuring the size of the tongue.

9) Srikar adikari et al Conducted a study to assess the usefulness of ultrasonogram in measuring the tongue thickness and anterior neck soft tissue at two levels namely hyoid and thyriod isthmus level to use this measurement in differentiating difficult laryngoscopy from easy laryngoscopy.Sample size was 50.Study design was prospective observational.All the ultrasound measurements were collected preoperatively.The Cormack-Lehane grading was done on the

day of surgery.They concluded that ultrasound measurement of anterior neck thickness was useful in identifying difficult airway.(24)

10) Karim lakhal et al ; 2007 Conducted a study to assess the usefulness of ultrasonogram to measure the airway diameter , that might help in choosing the correct size endo tracheal tube. Sample size chosen was 19 .They used the ultrasonogram to measure the cricoids lumen diameter in the transverse plane. They compared this value with MRI measurement of the cricoids lumen.They found positive correlation between USG measurements and MRI measurements. They concluded that ultrasonogram is useful in measuring subglottis diameter.

11) Deepak gupta et al 2012 Conducted a study to compare and correlate the ultrasound view of the airway and the Cormack Lehane classification of the direct laryngoscopy.The study was conducted on patients scheduled for elective surgery and requiring general anesthesia with direct laryngoscopy and endotracheal intubation. In the pre-operative holding area, the following measurements were obtained with the oblique-transverse ultrasound view of the airway: (a) the distance from the epiglottis to the midpoint of the distance between the vocal folds, (b) the depth of the pre-epiglottic space, and (c) the total time taken by the operator to achieve the final ultrasonic image.The data was then compared with the Cormack Lehane classification during direct laryngoscopy in the operating room. Subsequently based on the correlation data, the ultrasonographic modification

of Cormack- Lehane classification was developed.They observed that there was a negative correlation of the distance between the epiglottis and the vocal cords (E-VC) with the Cormack Lehane grading subsequently,the correlation of the pre-epiglottis space (Pre-E) Finally the ratio of Pre-E and E-VC distances with the Cormack Lehane grading had the strongest positive correlation.They found that prediction of Cormack Lehane (CL) grades can be adequately (67%-68% sensitivity) made by the ratio of Pre-E and E-VC distances.The average time taken to complete the ultrasound examination of airway in the preoperative area was 31.7 ± 12.4 seconds.They concluded that the non-invasive ultrasonographic modification of invasive Cormack-Lehane classification for pre-anesthetic airway assessment can supplement the presently available non- invasive modalities of pre-anesthetic airway assessment including the Mallampatti's classification with the Cormack Lehane grading was strong in positive direction .

12) Shiga et al ; conducted a study to assess the accuracy of clinical airway assessment for identifying difficult intubation.They selected previously done studies from data bases**.**The total studies chosen were 35 and the total patients included were 50,760.The clinical assessment tests used in this study were Mallampatti's test,thyromental distance,sterno mental distance,mouth opening and Wilson's score.The sensitivity and specifity of each test was calculated individually.The individual sensitivity for each test was 20% to 62% which means

the sensitivity was poor.The individual specifity for each test was 82% to 97%. which means the specifity was moderate.On calculating the positive likelihood ratio for combination of test,it was found that Mallampatti's distance and Thyromental distance was useful.They concluded that the individual clinical assessment tests were poor tools in identifying difficult intubation and the combination of tests improve the diagnostic ability.

13) Ezri et al conducted a study to assess whether increased soft tissue thickness at vocal cord level as measured by ultrasonogram is useful in identifying difficult intubation.50 morbidly obese patients were chosen.Using ultrasonogram, thickness of neck tissue at the level of vocal cords was measured.Totally 9 patients had difficult laryngoscopy.These patients had increased thickness of soft tissue which was statistically significant.They conclude that increased thickness at vocal cord level is useful in identifying difficult intubation. (23)

14) Prasad et al Conducted a study to compare ultrasound airway measurement and computed sonography airway measurements.15 patients included in the study were subjected to both ultrasound measurement of airway and computed tomographic measurement of airway at the suprahyoid level and infra hyoid level.The results were compared and analyzed for any statistical significance.They concluded that there was no statistically significant difference between the two modalities of measurements at the supra hyoid region.So ultra sound can be used to assess airway.

15) White and Kanser in1975 studied radiographs of the mandible,upper jaw and cervical spine in thirteen patients in whom direct laryngoscopy was difficult.They found that posterior depth of mandible was the most important factor for determining the ease of direct laryngoscopy and an increase in this distance hinders the displacement of soft tissues by larygoscope blade.

16) Nichole and Zuck in1983 suggested that the atlanto-occipital distance is a major anatomical factor that determines the ability to extend the head on the neck and exposure of larynx.

17) Patil, Stehling and Zander (1983) suggested that if during the initial clinical examination existing signs of a potentially difficult intubation supplement a distance less than 6.0cms between the lower border of chin and the thyroid notch, then intubation is going to be difficult and fiberoptic bronchoscopy is indicated.(8)

18) In 1983, Mallampatti SR hypothesized that concealment of faucial pillars and uvula by the base of the tongue rendered the exposure of larynx by direct laryngoscopy difficult.He evaluated his hypothesis on 210 adult patients. Visibility of oropharyngeal structures were noted and graded.He evaluated his hypothesis on 210 adult patients and showed significant correlation between ability to visualize pharyngeal structures and ease of laryngoscopy.In 155 patients

with class I exposure,all had easy visualization at laryngoscopy (100%).In 40 patients with class 2 exposure, laryngoscopy was easy in 26 patients and difficult in 14 patients.In 15 patients with class 3 exposure,only one patient had easy laryngoscopy and in all other patients laryngoscopy was difficult. (4)

MATERIALS &METHODOLOGY

It was a prospective comparative cross sectional study conducted in Department of Anaesthesiology,Govt.Kilpauk medical college.100 adult patients satisfying inclusion criteria were enrolled in the study.

Inclusion Criteria:

1) Adult patients undergoing elective surgery requiring general anaesthesia.
2) ASA physical status 1 – 2
3) Patients with age >18 years and <60 years
4) Patients with height:150-180cm
5) Patients who have given valid informed consent

Exclusion Criteria:

1) Patients not satisfying inclusion criteria.
2) Patients requiring techniques such as rapid sequence induction.
3) Patients with oral pathology with distorted anatomy,
4) Patients with trismus.
5) Pregnant patients.
6) Patients who are unconscious or severely ill.
7) Morbidly obese patients.

8) Patients with neck swelling/thyroid.

9) Patients with temporomandibular joint pathology

10) Patients with post burns contracture neck.

MATERIALS :

Macintosh Laryngoscope

High frequency ultrasound machine (7.5 MHz)

Measuring tape calibrated to 0.5cms

Goniometer

Ultrasound gel

Weighing machine

AIRWAY ASSESSMENT:

Previous anaesthesia records,h/o voice change, previous surgery, snoring, burns,trauma,tumour in oral cavity,neck,cervical spine were asked.H/O systemic illnesses like Diabetes mellitus, Rheumatoid Arthritis,Ankylosing Spondylitis were asked and recorded.

General examination included examination for anomalies of mouth and tongue,temporo mandibular joint pathology,facial anomalies, pathology of nose and palate.

Measurement of airway indices:

Individual indices were measured.

A-O Joint movement:

Patient was asked to look the ceiling without raising the eyebrows and the range movements noted.

Neck flexion: (7,9,11)

Patient was asked to touch the manubrium sterni with the chin and the range of movements noted.

Upper lip bite test:

The patient was asked to bite the upper lip with the lower incisor and graded as follows

Class 1:lower incisors can bite the upper lip above the vermilion line.

Class2:lower incisors can bite the upper lip below the the vermilion line.

Class3:lower incisors cannot bite the upper lip.

TMJ function:

The patient was asked to open his mouth widely and asked to place his index, middle and ring fingers in the opening and noted.The examiner's index finger placed in front of the tragus and the thumb in front of the lower part of the mastoid process behind the ear.The patient was asked to wide open his mouth and the sliding function of mandibular condyles was assessed.

Sternomental distance:

Measured the distance between sternal notch and symphisis menti when the neck was fully extended and mouth closed.

Thyromental distance:

Measured the distance between symphisis menti and the thyroid notch with full extension of neck.

Examination of dentures:

Abnormalities like cracked tooth,buck tooth,loose tooth,artificial dentures and missing tooth were examined and recorded.

Neck circumference:

Measured with inch tape at the level of thyroid notch in centimeter.

Samsoon and Young modification of Mallampatti grading:

The patient was kept in sitting posture with maximum opening of mouth,without any phonation and observer's eye is in level with the patient's mouth.The degree to which the uvula,faucial pillars,soft palate and hard palate were visible were recorded and classified as follows:

Grade I : Soft palate,hard palate, faucial pillars, uvula seen.

Grade II : Soft palate, hard palate and uvula seen

Grade III : Soft palate and base of uvula or none seen.

Grade IV : hard palate alone (7)

Inter incisor distance: Maximum distance between the upper and lower incisors when the patient's mouth is wide open.It was measured in centimeters using an inch tape.The measurements made were recorded.

Ultrasound measurement of thickness of soft tissue in anterior neck

The thickness of anterior neck soft tissues from the skin, was measured at 3 different levels.

Level 1 : skin to vocal cord thickness

Level 2 : skin to tracheal ring thickness at the thyroid isthmus level.

Level 3 : skin to tracheal ring thickness at the suprasternal notch level..(6,7)

Patient position : The patient was made to lie down supine with head in neutral position without a pillow under head.Patient was instructed to keep the mouth closed and to take slow breaths during measurements to minimize errors in recordings due to movements during respiration._*Ultrasound machine control settings* : The following controls were set in the ultrasound machine for obtaining the airway assessment measurements and images.

- Transducer - Linear high frequency transducer
- Axis/Plane - Short axis/Transverse plane

- Frequency - 11 MHz
- Depth - 3.0 cms - 4.0 cms
- Gain - 20 - 30.

The amount of soft tissue at each zone is calculated by averaging the amount of soft tissues in mm obtained in the central axis of neck.

The patients were then taken back to their wards. The next day morning on the day of surgery the patients were shifted to their respective operating rooms and the standard general anesthesia procedure was performed as per the discretion of the attending anesthesiologist.The following were kept ready.

→ Anesthesia machine and circuits checked,

→ Endotracheal tubes → cuffed portex tubes of appropriate size and one size lower than required.

→ Macintosh laryngoscope → with appropriate and large sized blade.

→ oral and Nasopharyngeal airway

→ Laryngeal mask airway of appropriate size

→ Functioning suction apparatus

→ Malleable stylet / Magill's forceps.

→ Monitors → ECG monitor and Pulse oximeter, Sphygmomanometer

→ Emergency drugs → Atropine, Adrenaline, Dopamine,Inj. Lignocaine 2% , 4%.10% for airway blocks

In case of anticipated difficulty in intubation, fiberoptic bronchoscopy was kept ready.

The following standardization measures were taken before obtaining Cormack Lehane grading and Intubation Difficulty Scale.

a) The attending anesthesiologist had an experience in the field of anaesthesiology for at least a minimum of 5 years.

b) All patients were connected to monitors - ECG,NIBP,PULSE OXIMETER ,ETCO2 and any additional monitors required as per the type of surgical procedure were kept ready.

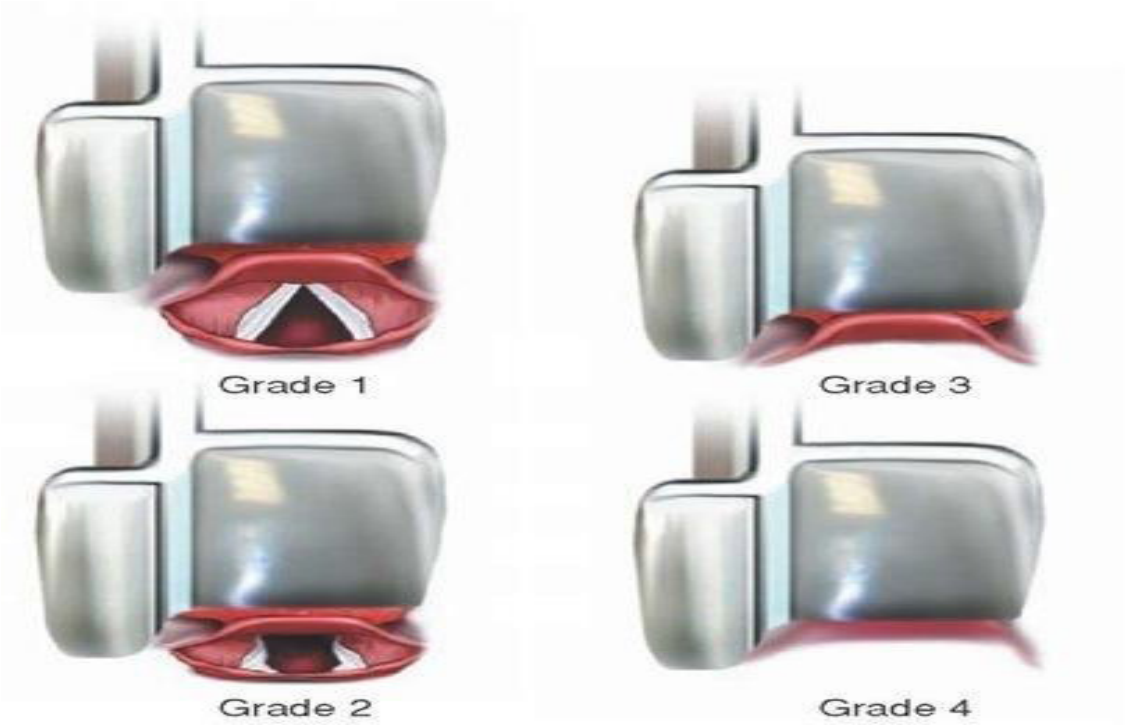
c) All patients were premedicated, preoxygenated, induced and paralysed using drugs according to the choice of the attending anesthesiologist before intubation.

c) A macintosh appropriate size blade was used for laryngoscopy.

d) The anaesthesiologists were asked to grade the vocal cord view as per Cormack Lehane grading.The best view obtained at the first attempt

by the laryngoscopy without any external maneuver were applied was taken as the Cormack Lehane classification.

Fig.20 Cormack and Lehane grading



CORMACK AND LEHANE GRADING SYSTEM:

Entire vocal cord visualized	-	Grade I
Posterior part of vocal cords seen	-	Grade IIa
Arytenoids only seen	-	Grade IIb
Epiglottis only seen (liftable)	-	Grade IIIa
Tip of epiglottis only seen (adherent)	-	Grade IIIb
No glottis structure seen	-	Grade IV

INTUBATION DIFFICULTY SCALE

Parameter	Score
Number of attempts >1	N1
Number of operators >1	N2
Number of alternative techniques	N3
Cormack Grade -1	N4
Lifting force required	
Normal	N5=0
Increased	N5=1
Laryngeal pressure	
Not applied	N6=0
Applied	N6=1
Vocal card mobility	
Abduction	N7=0
Adduction	N7=1
Total Score IDS=Sum of scores	N1-N7

Rules for calculating IDS score	IDS score	Degree of difficulty
N1 Every additional attempt adds one point	0	Easy
N2 Each additional operator adds one point	0 <IDS ≤5	Slight
N3 Each alternative techniques adds one point	IDS >5	Moderate to major
N4 Apply Cormack grade for the first oral attempt	IDS =∞	Impossible
N5 Sellick's manoeuvre adds no point		

The IDS scale was noted.

Intubation time:measured from entry of the laryngoscope into the oral cavity and proper confirmation of endotracheal tube.

The surgery was carried out and after surgery was over the patients were reversed and extubated.They were observed for half an hour post operatively for full recovery and then the patients were shifted to the post operative wards for further management.

The collected data were recorded for further statistical analysis.

STASTITICAL ANALYSIS

Data were analyzed with SPSS version 14 (SPSS Inc., Chicago,IL, USA.2011) and Microsoft excel.The alpha error was set at 0.05and type II error was set at 0.20.The independent sample, two-tailed T test or one-way analysis of variance or Levene's T test was used for parametric data while Mann–Whitney U test or Chi-square test was used for non parametric data as appropriate.An P value less than 0.05 was considered statistically significant.Sample size was calculated by using formula $n=(u+v)^2 \times(SD1^2+SD2^2)\div($ with atleast 100 sample size needed to detect a difference with more than 80% power of study at 5% significance level.

OBSERVATION AND RESULTS

This prospective,comparative,cross sectional study predicting the intubating conditions with measuring anterior soft tissue thickness using ultrasonogram and neck circumference and evaluated the advantages,effective airway management plan and airway time.

All data were collected and tabulated.

DEMOGRAPHIC VARIABLES:

100 patients were randomly selected and included in this study.

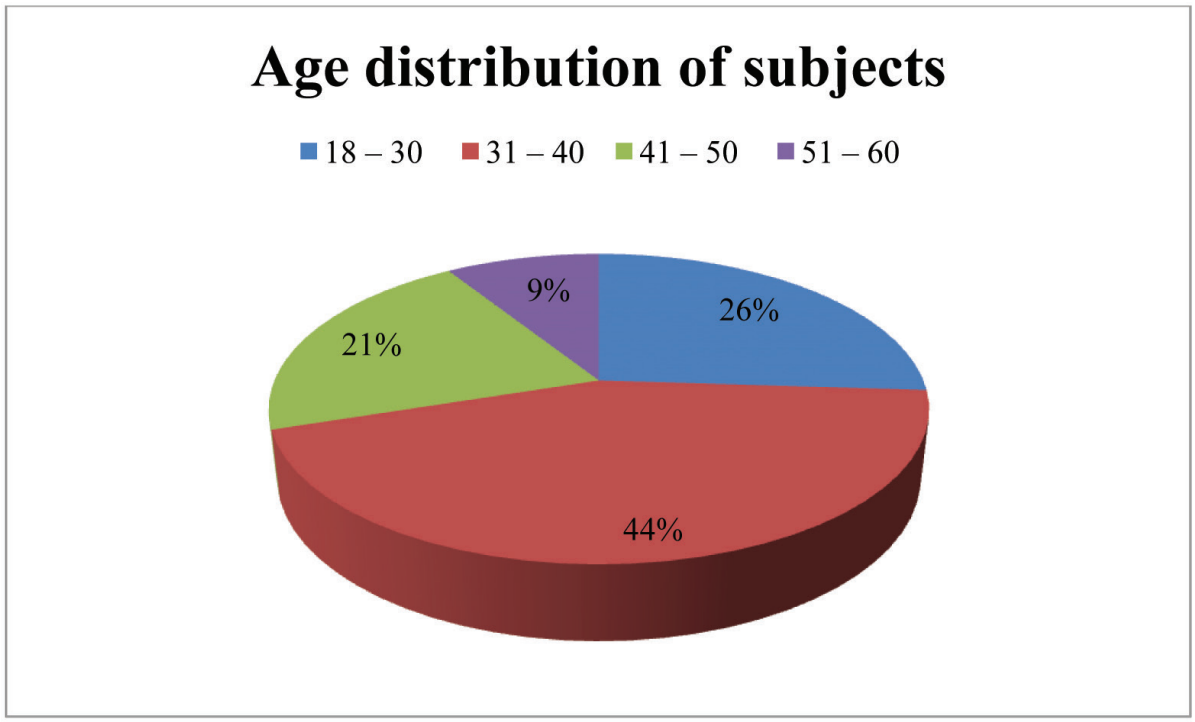
AGE DISTRIBUTION:

Age group of the patients range from 18 yrs to 60 yrs.Majority of the study population were in 18 to 40 years age group.

Table 1. Age distribution of study subjects

Age (in years)	Number
18 – 30	26
31 – 40	44
41 – 50	21
51 – 60	9
Total	100

FIG21:Age distribution of subjects

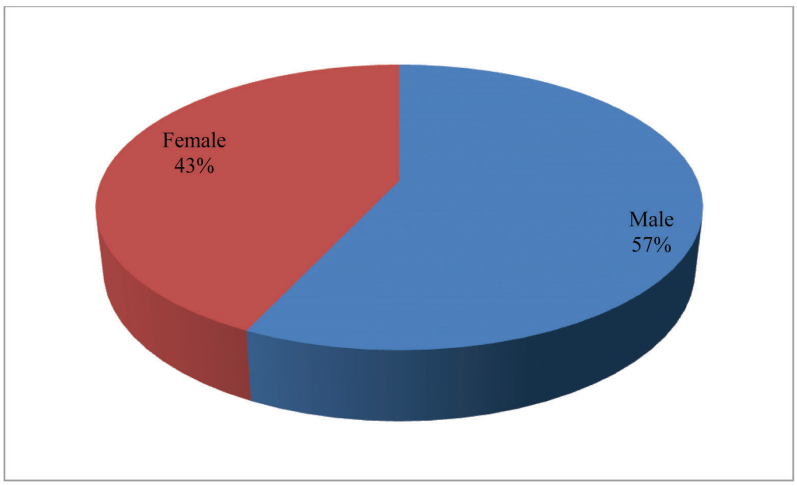


SEX DISTRIBUTION:

Table 2.Sex distribution of study subjects

Sex	Number
Male	57
Female	43
Total	100

FIG22: Sex distribution of study subjects

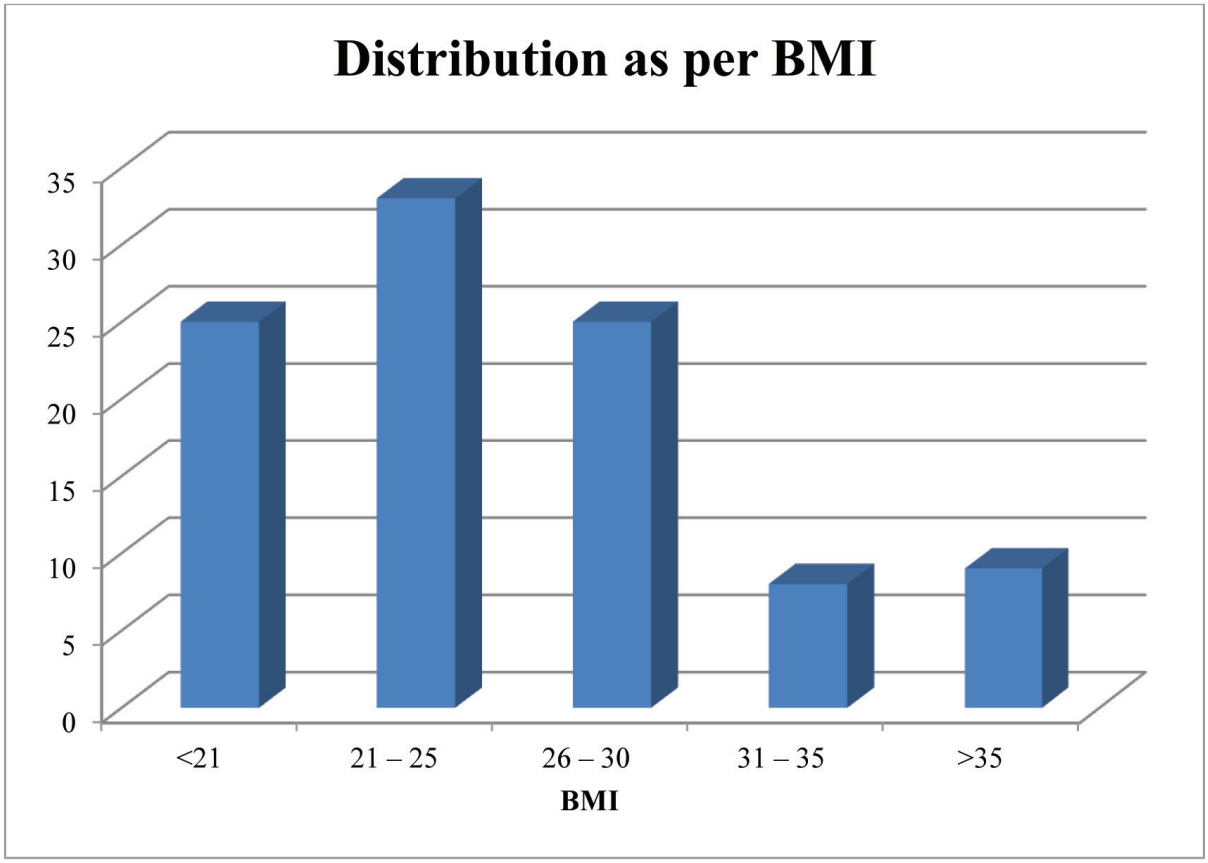


BODY MASS INDEX: Body mass index of patients ranged from 18 to 40.

Table 3.Distribution of study subjects based on BMI

BMI	Number
<20	25
21 – 25	33
26 – 30	25
31 – 35	8
>35	9
Total	100

FIG23:Distribution as per BMI

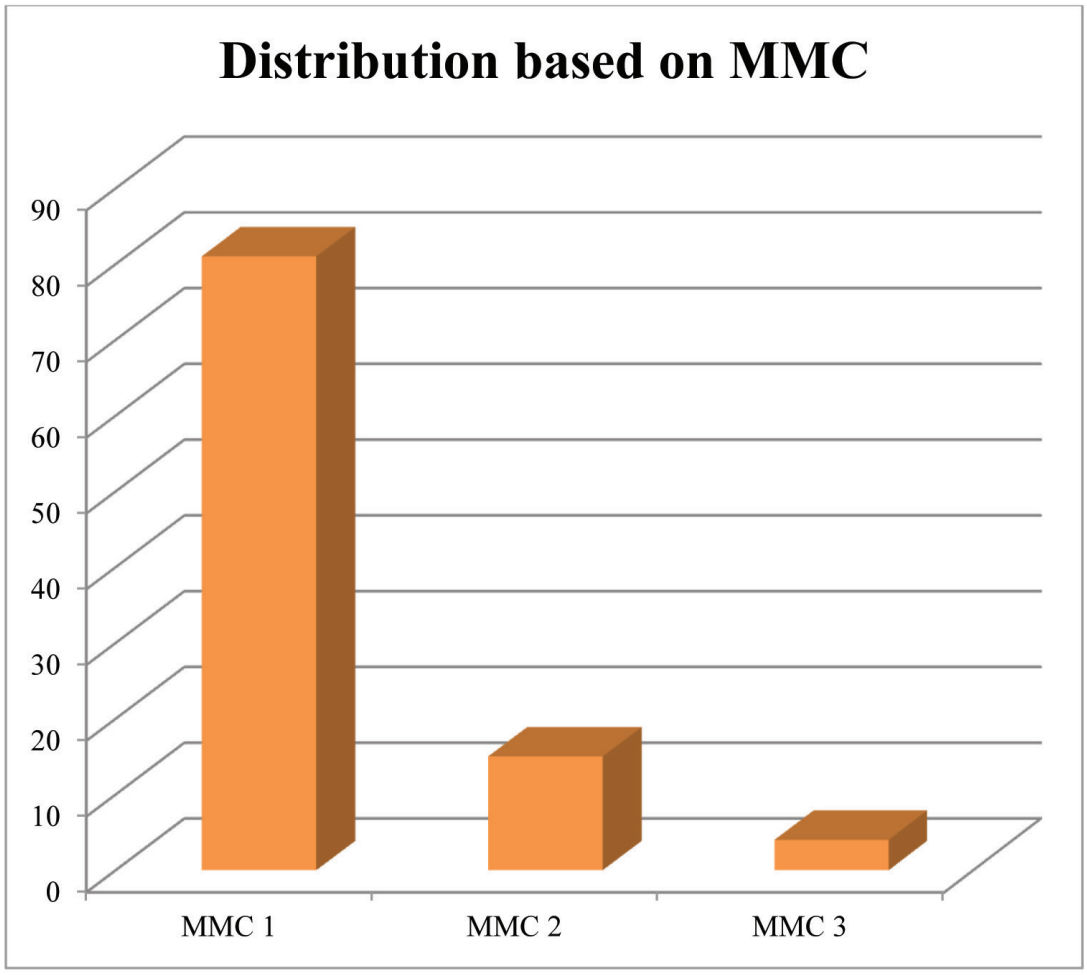


MODIFIED MALLAMPATTI CLASSIFICATION:

Table 4.Distribution of study subjects based on MMC

MMC	Number
1	81
2	15
3	4
Total	100

FIG24:Distribution based on MMC

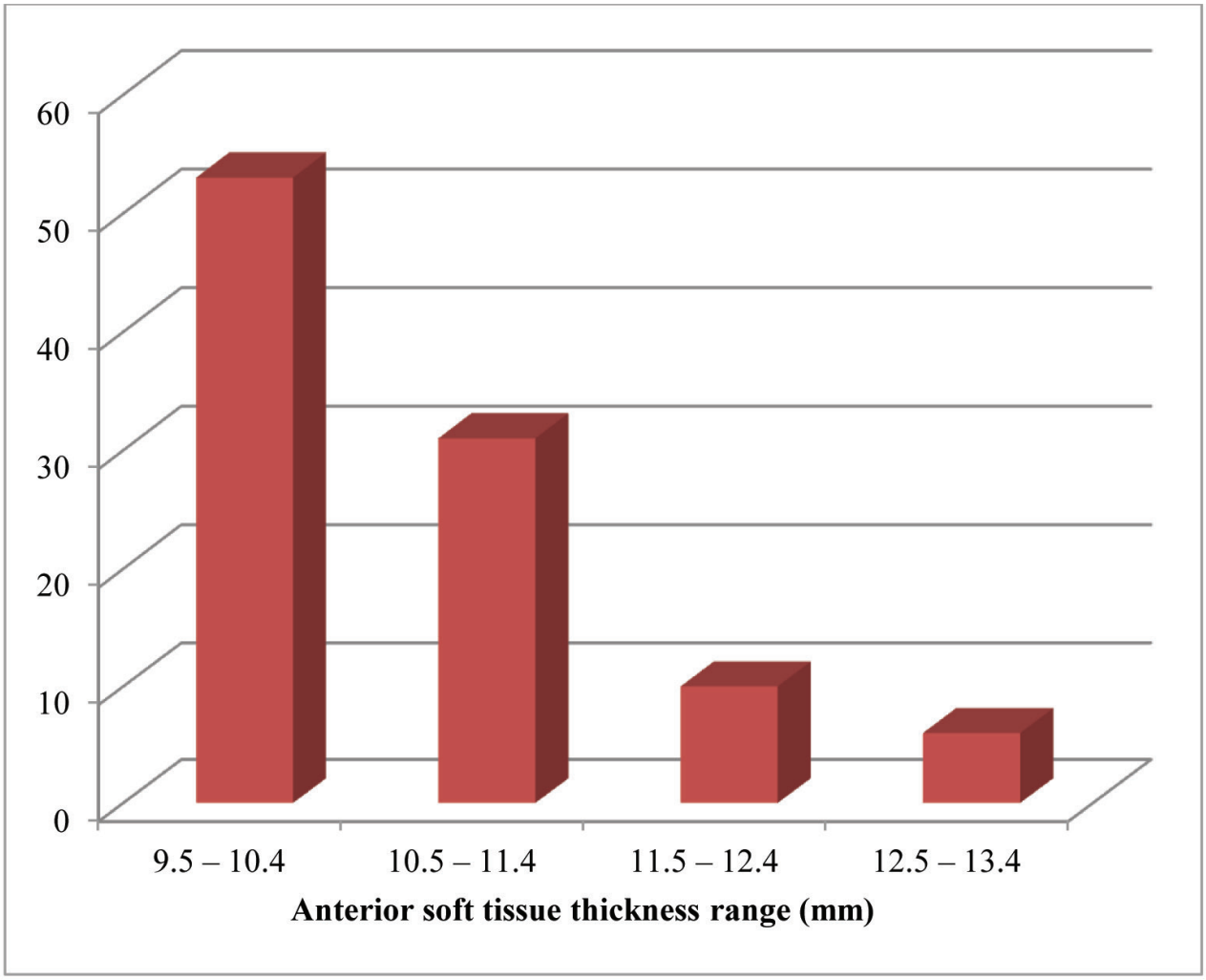


ANTERIOR SOFT TISSUE THICKNESS: Anterior soft tissue thickness of neck measured at three levels (vocal cords,thyroid isthmus and suprasternal notch) and their mean value calculated and tabulated.

Table 5.Distribution of study subjects based on Anterior soft tissue thickness range

Anterior soft tissue thickness range (mm)	Number
9.5 – 10.4	53
10.5 – 11.4	31
11.5 – 12.4	10
12.5 – 13.4	6
Total	100

FIG25:Distribution based on anterior soft tissue thickness

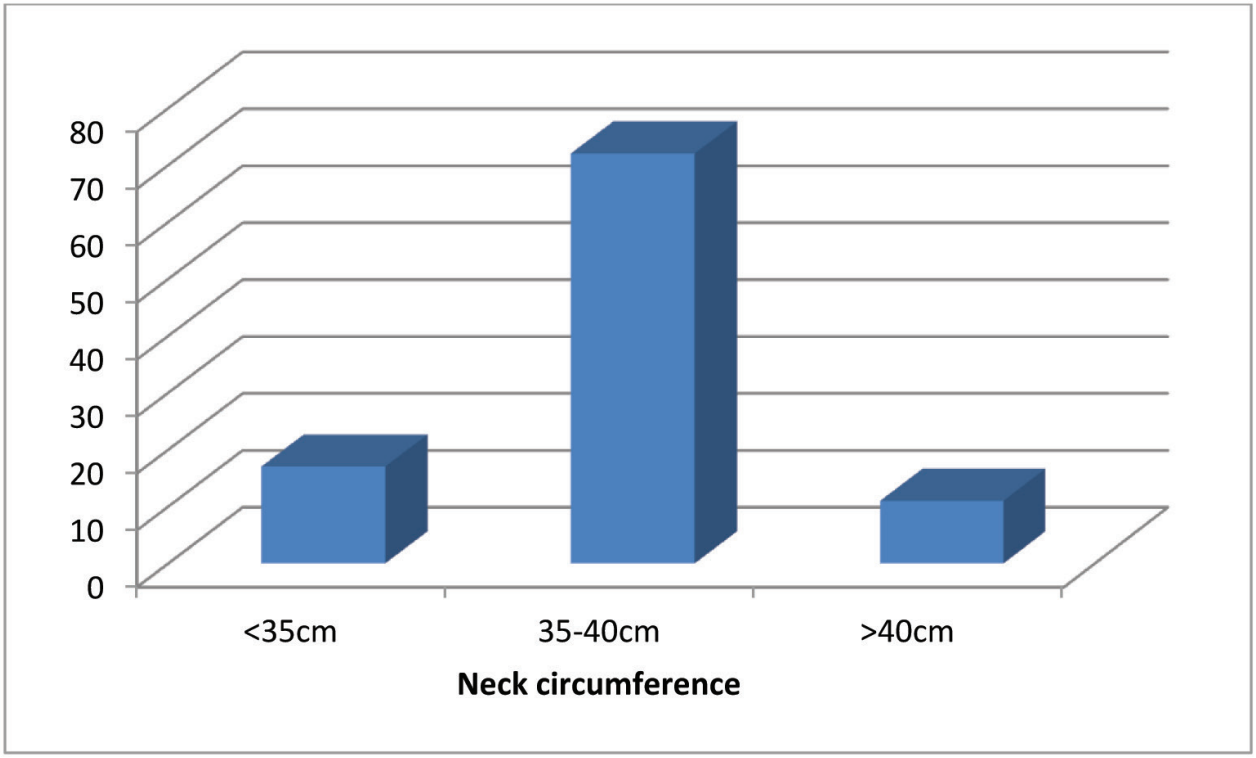


NECK CIRCUMFERENCE: Measured in cm at the level of thyroid notch and the measured values were tabulated.

Table6:Distribution of study subjects based on neck circumference

Neck circumference	Number
<35cm	17
35-40cm	71
>40cm	12
Total	100

FIG26:Neck circumference



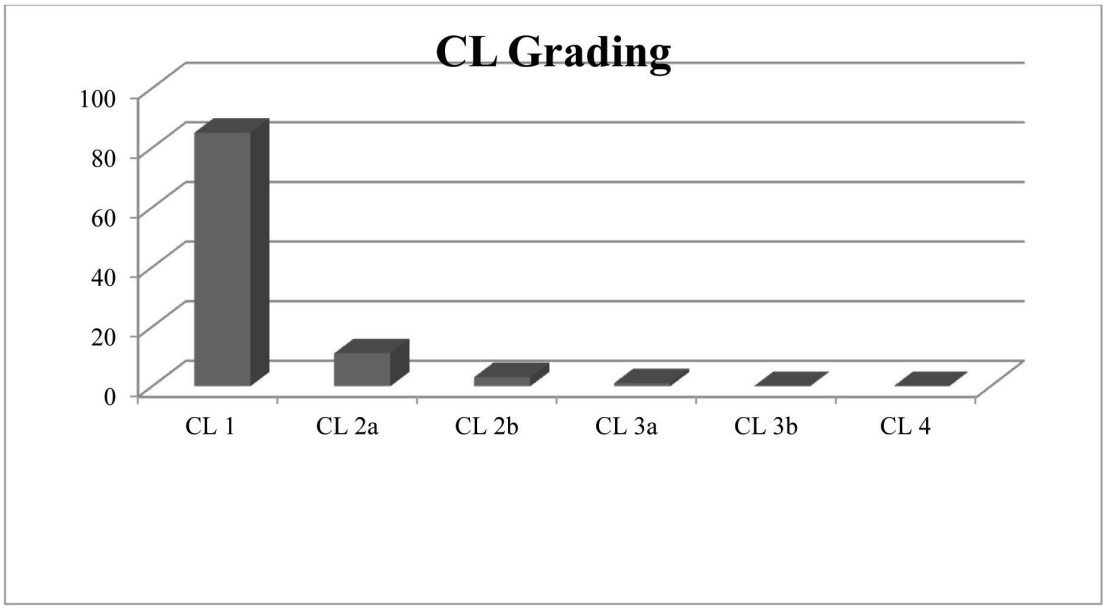
OUTCOME MEASURES:

Cormack and Lehane grading: Cook's modification of Cormack and Lehane classification was used to grade laryngeal view.

Table 7.Distribution of study subjects based on CL grading

CL grading	Number
1	85
2a	11
2b	3
3a	1
3b	-
4	-
Total	100

FIG:27Distribution based on CL grading

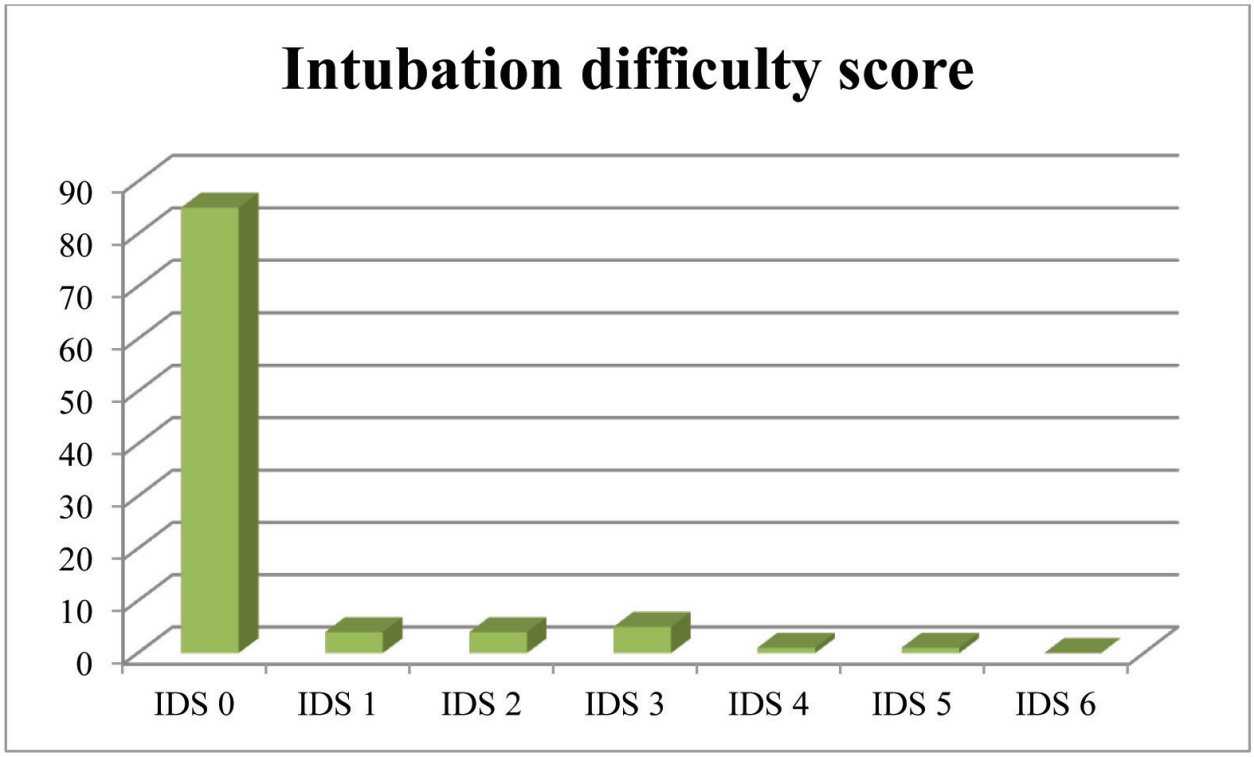


INTUBATION DIFFICULTY SCORE:

Table 8.Distribution of study subjects based on IDS

IDS	Number
0	85
1	4
2	4
3	5
4	1
5	1
6	-
Total	100

FIG28:Distribution based on IDS



Intubation difficulty score of 0 considered as easy and more than or equal to 1 considered as difficult

IDS	**Numbers**
EASY	85
DIFFICULT	15

ANTERIOR SOFT TISSUE THICKNESS AND IDS :

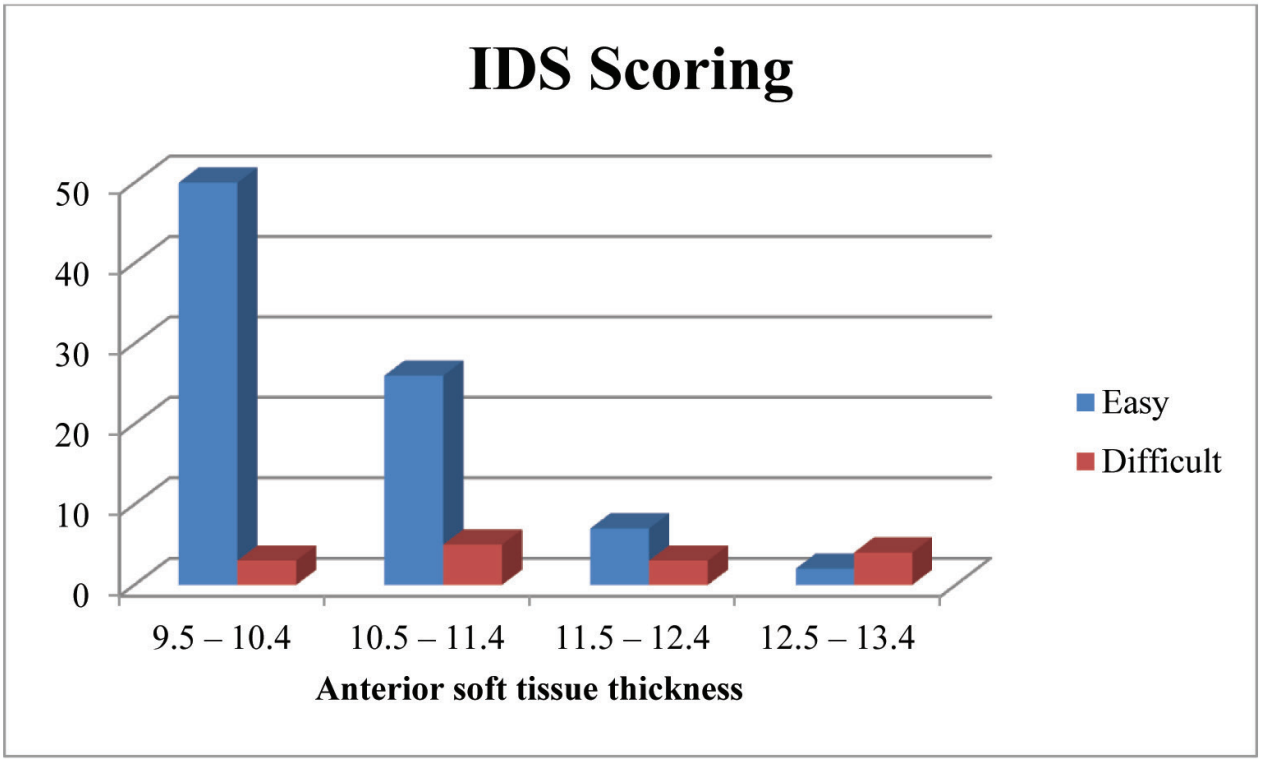
Anterior soft tissue thickness measured at three levels and the mean values that obtained were categorized and divided into four groups and statistical analysis was done.

Table 9.Association of anterior soft tissue thickness and IDS scoring

Anterior soft tissue thickness	IDS scoring		Chi-square	P value
	Easy (%)	Difficult (%)		
9.5 – 10.4	50 (58.8)	3 (20.0)	17.98	0.0004
10.5 – 11.4	26 (30.6)	5 (33.3)		
11.5 – 12.4	7 (8.2)	3 (20.0)		
12.5 – 13.4	2 (2.4)	4 (26.7)		
Total	85	15		

The results were analysed using Chi-square test and the correlation of increased anterior soft tissue thickness of neck with difficult intubation was highly statistically significant. P value=0.0004

FIG29:Association between anterior soft tissue thickness and IDS



NECK CIRCUMFERENCE AND IDS:

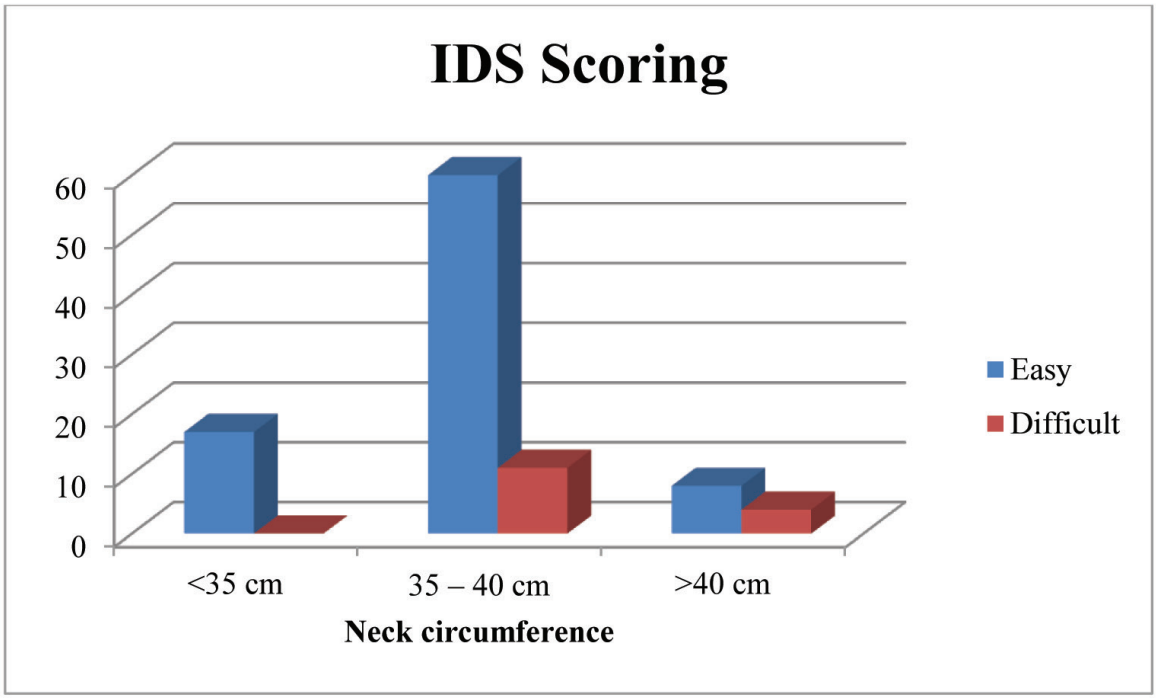
Neck circumference of study population was divided into three categories (<35cm,35-40cm,>40cm**).**

Table 10.Association of neck circumference and IDS scoring

Neck circum-ference	IDS scoring		Chi-square	P value
	Easy (%)	Difficult (%)		
<35 cm	17 (20.0)	0	6.18	0.046
35 – 40 cm	60 (70.6)	11 (73.3)		
>40 cm	8 (9.4)	4 (26.7)		
Total	85	15		

Results were analysed with Chi-square test and statistically less significant correlation was obtained with increasing neck circumference and difficult intubation**.**P value=0.046

FIG30:Association between neck circumference and IDS



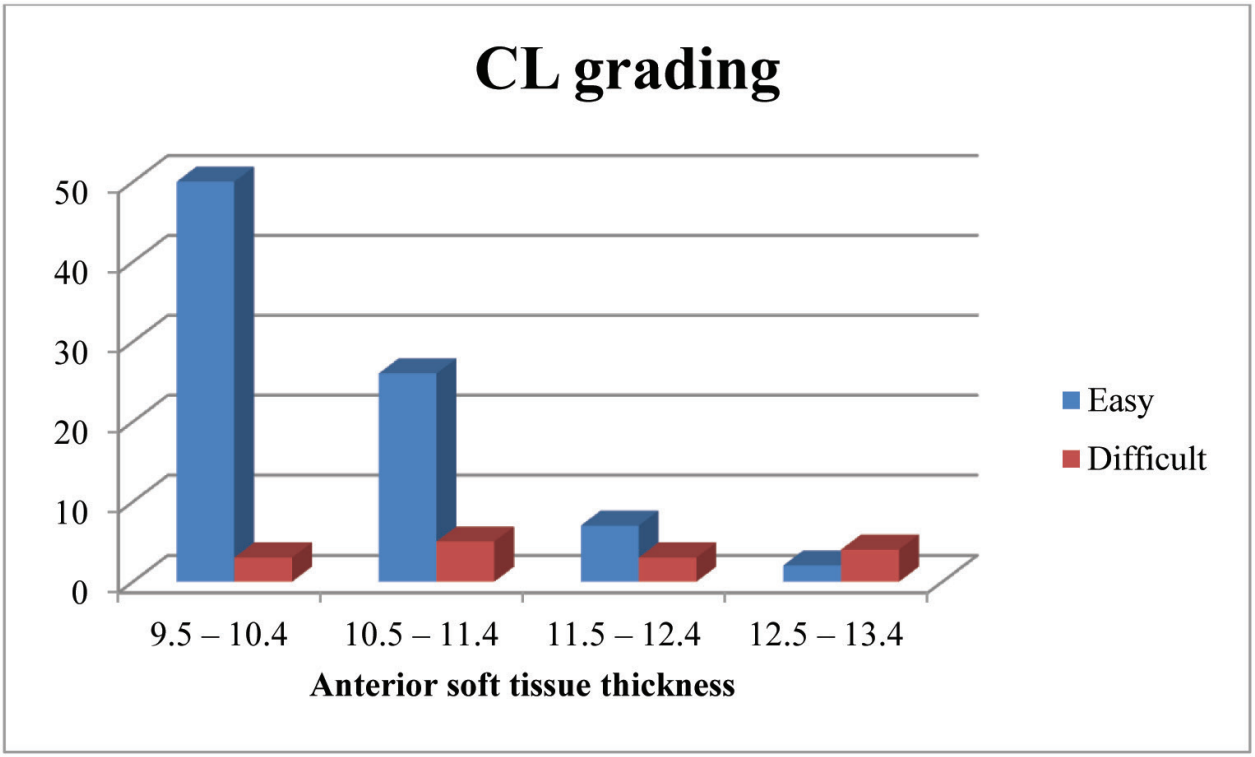
ANTERIOR SOFT TISSUE THICKNESS AND CL GRADING:

Table 11.Association of anterior soft tissue thickness and CL grading

Anterior soft tissue thickness	CL grading		Chi-square	P value
	Easy (%)	Difficult (%)		
9.5 – 10.4	50 (58.8)	3 (20.0)	17.98	0.0004
10.5 – 11.4	26 (30.6)	5 (33.3)		
11.5 – 12.4	7 (8.2)	3 (20.0)		
12.5 – 13.4	2 (2.4)	4 (26.7)		
Total	85	15		

The results were analysed by using Chi-square test and statistically significant correlation was obtained with increased pretracheal soft tissue thickness and CL grading.

FIG31:Association between anterior soft tissue thickness and CLgrading



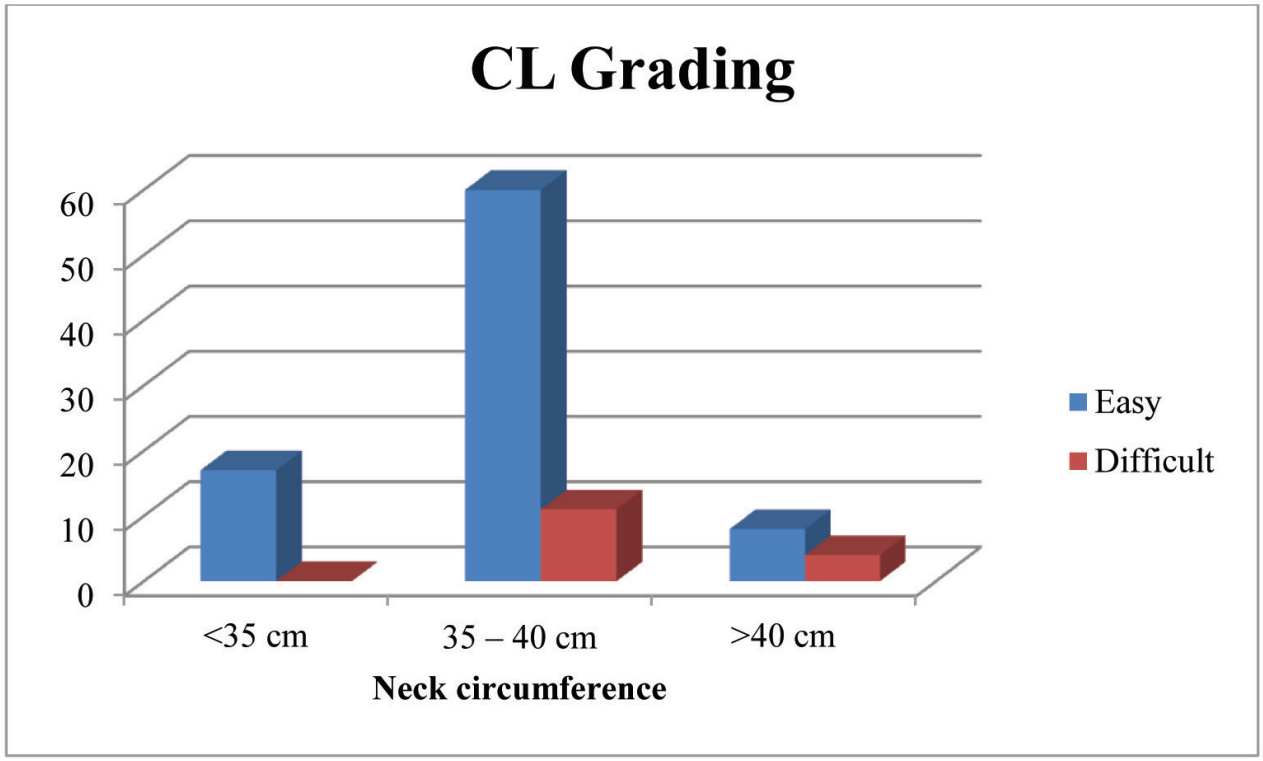
NECK CIRCUMFERENCE AND CL GRADING:

Table 12.Association of neck circumference and CL grading

Neck circum-ference	CL grading		Chi-square	P value
	Easy (%)	Difficult (%)		
<35 cm	17 (20.0)	0	6.18	0.046
35 – 40 cm	60 (70.6)	11 (73.3)		
>40 cm	8 (9.4)	4 (26.7)		
Total	85	15		

The results were analysed by using Chi-square test and statistically less significant correlation was obtained with increased neck circumference and CL grading.

FIG32:Association between neck circumference and CL grading



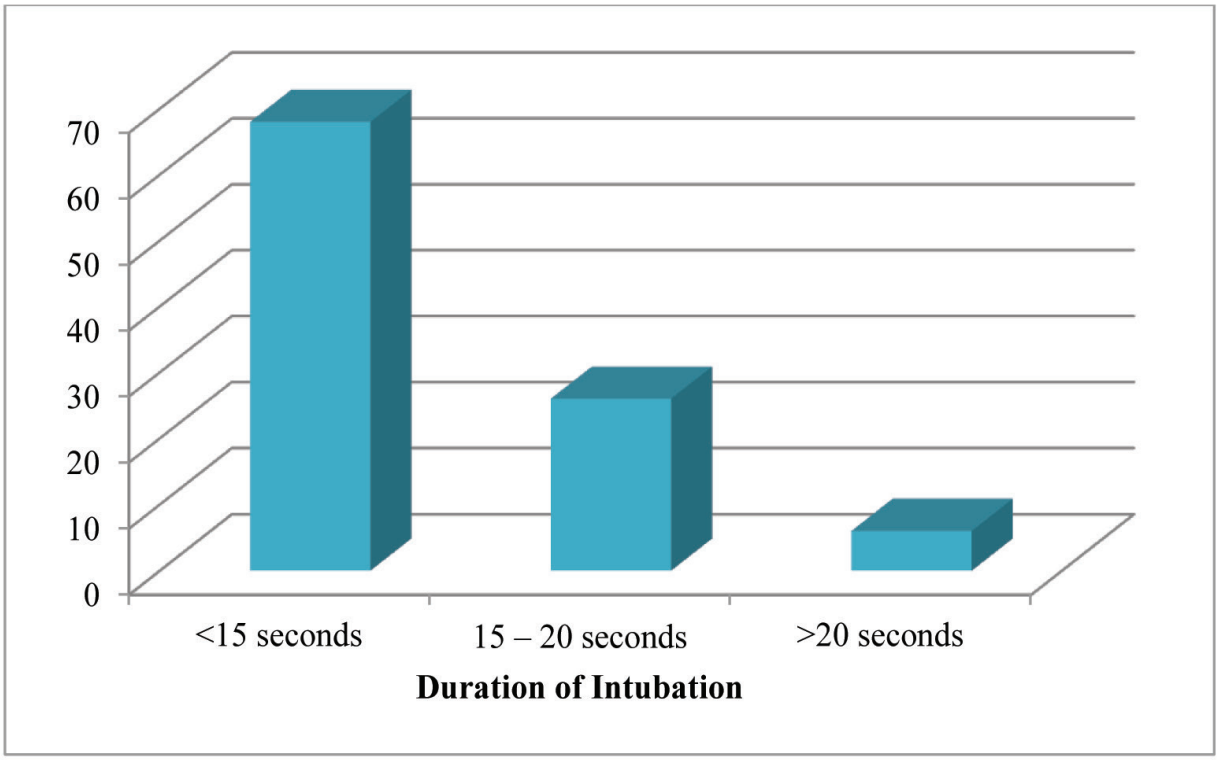
INTUBATION DURATION:

Mean duration was17 seconds.Range was 10 to 25 seconds.68 patients were intubated in10 to 15 seconds

Table 13.Distribution of study subjects based on Intubation Duration

Intubation duration	Number
<15 seconds	68
15 – 20 seconds	26
>20 seconds	6
Total	100

FIG33:Distribution based on intubation duration



ANTERIOR SOFT TISSUE THICKNESS AND INTUBATION

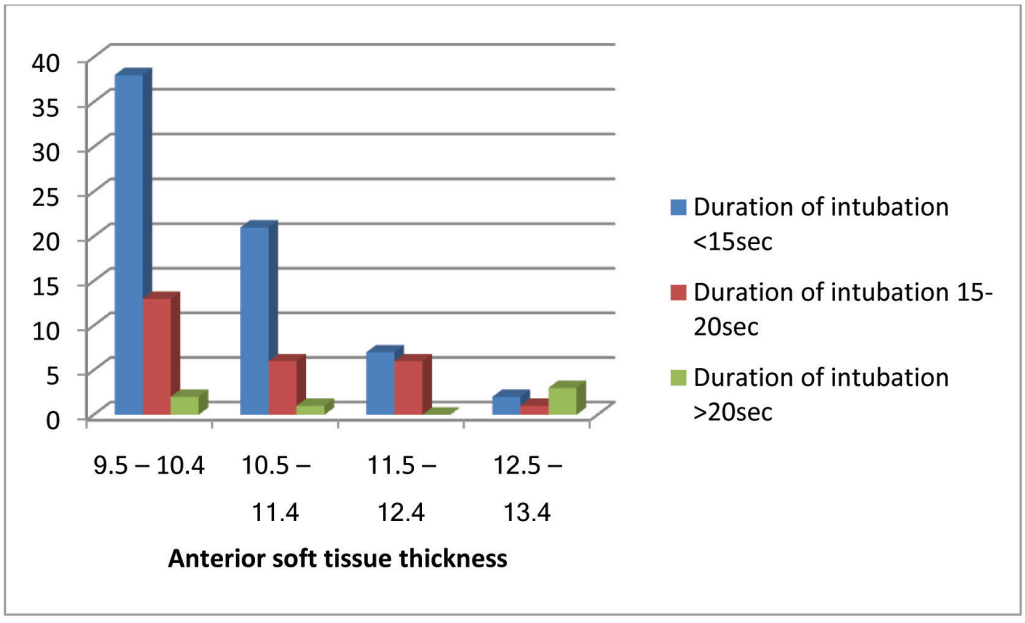
DURATION:

Table14.Association of anterior soft tissue thickness and duration of intubation

Anterior soft tissue thick-ness	Duration of intubation			Chi-square	P value
	<15sec	15-20sec	>20sec		
9.5 – 10.4	38	14	1	25.106	0.0001
10.5 – 11.4	21	8	2		
11.5 – 12.4	7	3	0		
12.5 – 13.4	2	1	3		
Total	68	26	6		

The results were analysed by using Chi-square test and statistifically significant correlation was obtained between anterior soft tissue thickness and intubation duration.

FIG34:ASSOCIATION BETWEEN ANTERIOR SOFT TISSUE THICKNESS NECK AND INTUBATION DURATION



DISCUSSION

Expert airway management is an essential skill for anesthesiologist.Difficult endotracheal intubation is mostly caused by difficult direct laryngoscopy with impaired view of vocal cords.Despite all the information currently available, no single factor reliably predict these difficulties.Unfortunately many difficult intubations are not recognized until after induction of anaesthesia.Unexpected difficult intubation lead to critical situation, especially who are difficult to ventilate by mask, who are at risk for gastric regurgitation and patients with limited cardiopulmonary reserve.

When a person is in supine position and head in the neutral position, the laryngeal axis is almost horizontal.The pharyngeal axis is 30-45^0 from the horizontal axis and the oral axis almost perpendicular to the laryngeal axis.For a successful direct laryngoscopy for the exposure of the glottis opening, the oral, pharyngeal and laryngeal axes alignment is required. Elevation of the head about 10cm with pads below the occiput aligns the laryngaeal and pharyngeal axes.

The knowledge of the anaesthesiologists in predicting difficult airway is very much confusing because of the various literatures providing multivariate indices.Inspite of various informations available now there is still lacking of a single factor in predicting difficulties.

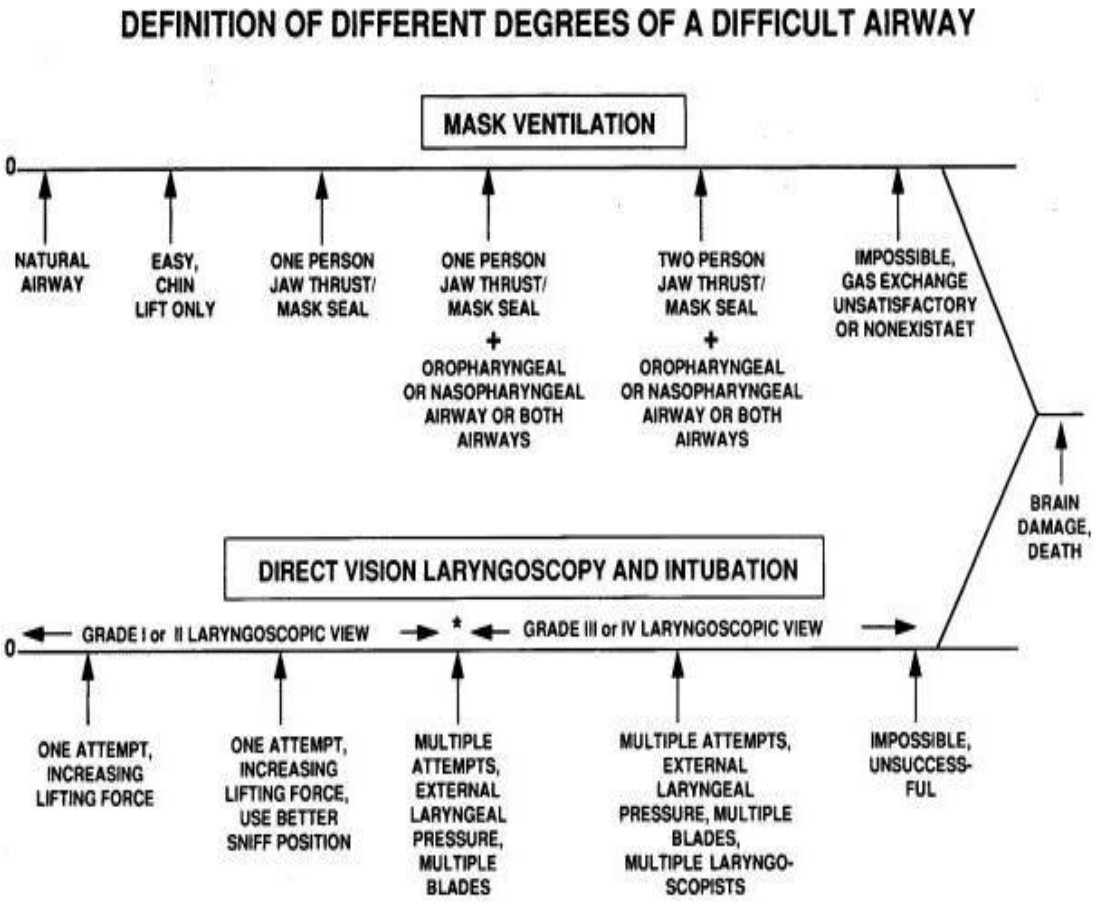
There have been lot of studies and numerous attempts in pursuit of a score to describe the complexity of intubation.Most of the methods are quite complicated involving various variables. Factors that have been associated with difficult laryngoscopy include larger neck circumference,decreased sternomental distance,limited neck movements,decreased thyromental distance,receding mandible,prominent buck teeth.Failure to maintain a patent airway has been recognized as a serious patient safety concern.There are 3 main ways by which patency of the airway can be maintained.

The first is the Bag and Mask ventilation in which gas exchange is maintained by applying a tight fitting mask over the patient's nose and mouth and providing oxygen for ventilation through the reservoir bag.The advantage of this method is i.e. a non-invasive procedure.Even though ventilation of a patient's lung can be achieved through this method, it is not considered as a definitive airway management technique.This is because any abnormality in the patient's head and neck such as completely edentulous makes the mask seal inadequate and excessive gas leak occurs. Other causes of difficult mask ventilation are obstruction of airway due to falling back of tongue, excessive soft tissues in weak patients, enlarged tonsils, airway edema, spasms of larynx and bronchus, foreign body obstruction of air passage, etc,.

The second method of airway maintenance is using of supraglottic airway devices.These devices are placed above the level of vocal cords and gas exchange is maintained through them.After its first use in the year 1981,the Laryngeal Mask Airway has undergone many generations of sophisticated modulations. Advantages of the LMA are insertion is easy requiring no advanced technical skills,minimizing the increase in various pressures (intra ocular,intra cranial,blood pressure) and improved tolerance to the device while still maintaining adequate gas exchange.Even this method is not considered definitive airway management because of the aspect of presence of open communication between the air passage and food passage leading to risk of aspiration.But the recent devices like proseal LMA prevent the risk of aspiration.

The third method of maintaining patent airway is Endotracheal tube insertion into the patient's trachea which is practically keeping the airway open by means of an artificial conduit for gases.This method is considered as definitive airway management.

Difficult airway is a situation in which gas exchange cannot be maintained through any one of the methods mentioned above thereby leading to respiratory related injuries.The three main causes of respiratory related injuries to the patient are inadequate ventilation, oesophageal intubation and difficult tracheal intubation. Difficult tracheal intubation accounts for 17% of the respiratory related injuries and results in significant morbidity and mortality.



While improvements in patient monitoring and availability of airway devices have reduced the risk associated with an unpredicted difficult airway,these changes have not reduced the incidence of unexpected difficult airways in clinical practice. Since the consequences of an unanticipated difficult airway are potentially life threatening to the patient, a method of through pre operative airway assessment has become an important necessity.

The airway assessment begins with a thorough history regarding, previous surgeries,intubations and trauma to head and neck regions that might indicate any

chance of occurrence of difficulty in intubation.

A thorough general physical examination and examination of airway reveals information that might help in predicting occurrence of difficult intubations.

In an attempt to avoid facing the situation of unanticipated difficult airway the anesthetists developed the method of preoperative airway assessment.The assessment technique was first started in the year 1980s when Vijayalakshmi Patil MD., suggested that the measure of anatomical structures present in head and neck has a role in occurrence of difficult airway.Around the same period Seshagiri Rao Mallampatti MD., developed a hypothesis to predict difficult airway based on the structures that are visible in the oropharynx while the patient's mouth is wide open and tongue ids protruded out.Various other clinical predictors of difficult airway have been developed and analyzed since then like, inter incisor gap,sternomental distance,neck mobility etc.These tests have been used for analysis as single test. But the predicted value of these tests when used alone was less.Hence the next step in preoperative airway assessment was the development of grouped indices like Wilson's score, Lemon assessment, Arne's simplified score, etc.

This was followed by radiographic predictors like X-ray neck in the lateral view to measure the C1 spine to occiput distance, length of the mandible and depth of mandibular space.The other radiographic predictors are Computed

Tomographic imaging of airway to look for any tumors, mass or compressions.In the recent past years, many advanced indices for predicting difficult airway have developed like Flow Volume Loop, Acoustic Response measurement,flexible bronchoscope and ultrasonogram airway assessment.During the past few years the field of anaesthesia has been gaining eyesight, with the aid of ultrasonogram. Ultrasonogram is a safe, non invasive and a real time imaging tool, the utility of which is being studied in recent years by anesthesiologists in various aspects. Some of the uses of ultrasonogram in the field of anesthesiology are ultrasound guided peripheral nerve blocks,vascular cannulations, regional anesthesia techniques,airway assessment,identification of lung and pleural pathologies, etc. In this study the usefulness of ultrasonogram in predicting difficult airway is analyzed.The main problem that was encountered in the past using ultrasonogram for airway assessment was the difficulty in visualizing the airway structures.The reason for this was that these structures were situated superficially and were filled with air that produced a high acoustic impedance and hence resulted in production of poor image quality.(13,14,15)

The modern ultrasound machines are made such that they have a multiarray and variable frequency transducer with cross beam imaging facility and improved lateral and spatial resolutions, so that the images obtained are high quality.A good

knowledge of clinical regional anatomy when combined with a good working knowledge of principles of ultrasound,Ultrasonogram can be used as a safe and reliable tool in clinical practice.

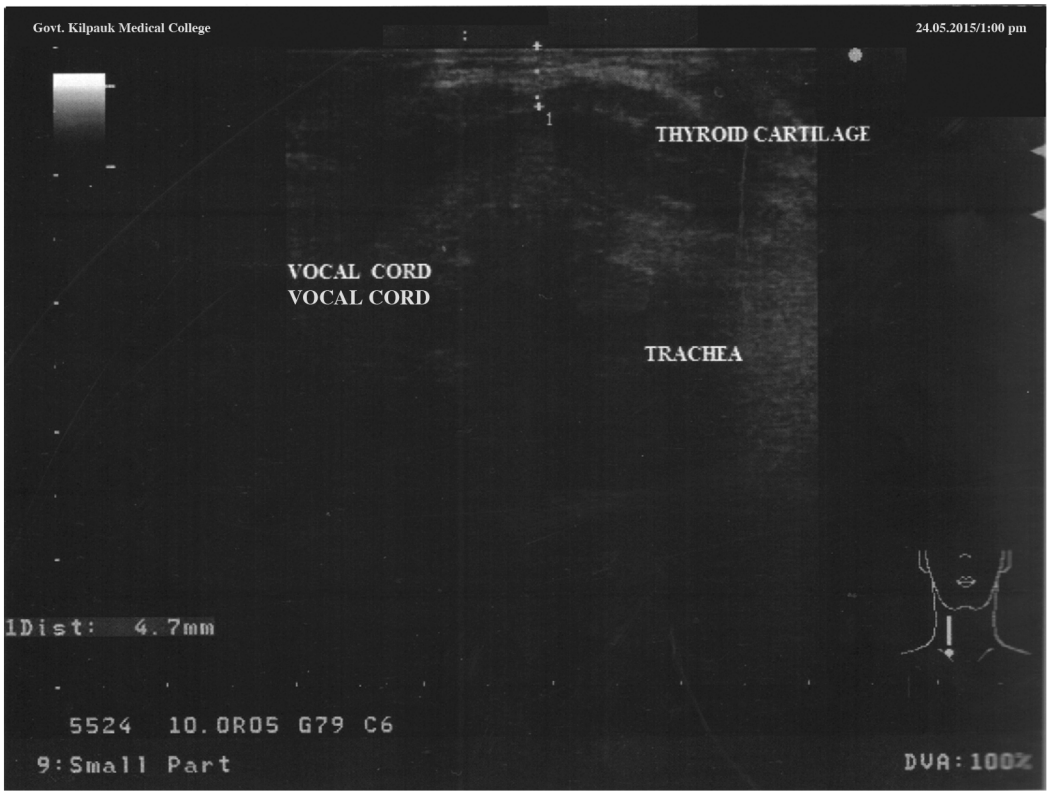
Prasad et al has studied the reliability of using ultrasonogram for airway assessment.They have compared the airway measurements in supra hyoid region and infra hyoid region taken by ultrasonogram and computed tomography.They concluded that the ultrasound measurements were comparable with those obtained from CT scan.But the correlation was found to be more in the infra hyoid region than in the supra hyoid region.

Many studies regarding ultrasound airway assessment have been conducted so far in many countries.In this study which is a prospective observational type of study,conducted in Indian population,we have assessed the usefulness of ultrasonogram in predicting difficult airway by measuring the thickness of anterior neck soft tissue at three levels namely,vocal cord level,thyroid isthmus level and suprasternal notch level. (20)

This study was designed to compare the usefulness of ultrasound guided measurement of pretracheal soft tissue thickness and neck circumference in predicting difficult airway.

ANTERIOR SOFT TISSUE THICKNESS

AT VOCAL CORD LEVEL



ANTERIOR SOFT TISSUE THICKNESS: In the study conducted by Ezri et al they concluded that increased thickness at vocal cord level is useful in identifying difficult intubation.

In my study anterior soft tissue thickness was measured by me at three levels namely at vocal cords,thyroid isthmus and suprasternal notch and their mean value was calculated and categorized into four groups and analysed(9.5-10.4,10.5-11.4,11.5-12.4,12.5-13.4).

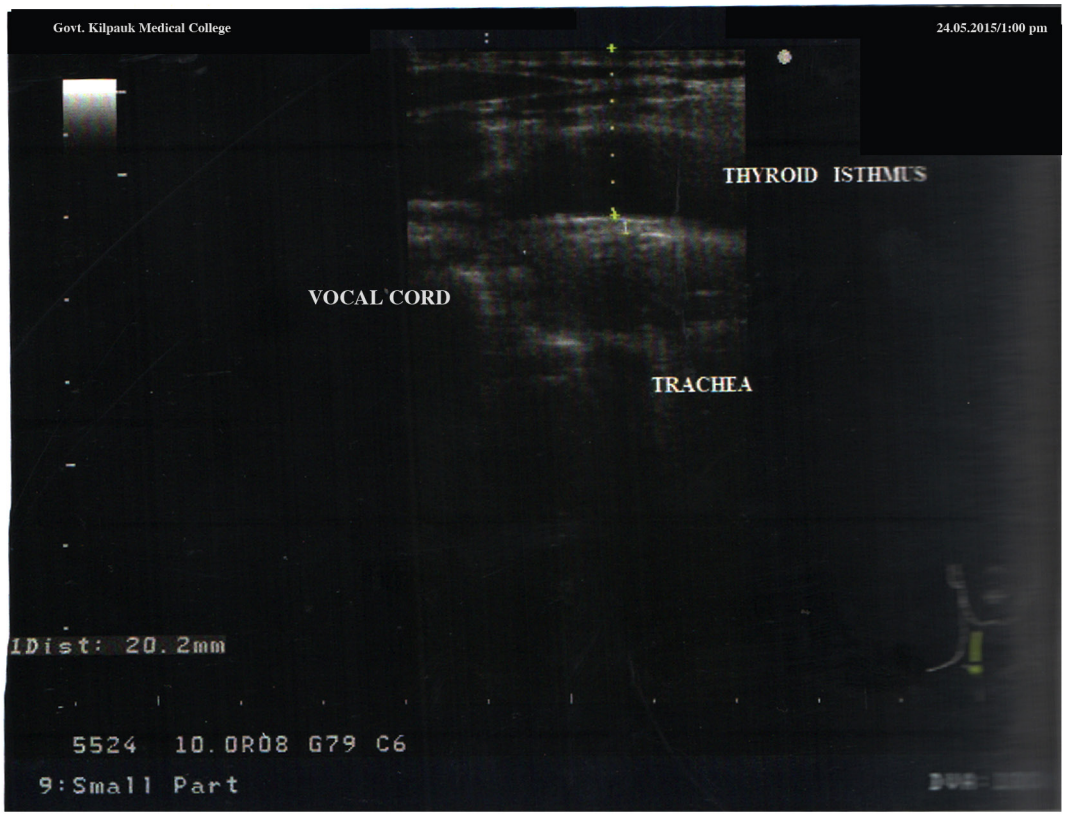
In the study conducted by Ezri et al there were 9 difficult laryngoscopy patients out of that 9 patients 7 had increased pretracheal soft tissue thickness.

In my study the total IDS Score was "0" in 85 out of 100 patients and ≥1 in the remaining 15 patients.In my study the patients with pretracheal soft tissue thickness in the range of 11.5-12.4 mm 3 out of 10 patients had IDS score ≥1 and in the range of12.5-13.4 mm 4 out of 6 patients had IDS score ≥1 and the results were subsequently analysed with Chi-square test and the correlation of increasing pretracheal soft tissue thickness with difficult intubation was statistically significant.

In my study the Cormack –Lehane grading was 1 in 85 out of 100 patients ,2a in 11 patients,2b in 3 patients and 3a in 1 patient.In my study in patients with pretracheal soft tissue thickness in the range of 11.5-12.4 mm 3 out of 10

ANTERIOR SOFT TISSUE THICKNESS

AT THYROID ISTHMUS LEVEL



patients had CL grading of 2 and in the range of 12.5-13.4 mm 3 out of 6 patients had CL grading of 2 and 1 patient had CL grading of 3. The results were subsequently analysed with Chi-square test and it showed that correlation of increasing pretracheal soft tissue thickness with difficult laryngoscopy and intubation as graded by CL grading was statistically significant.

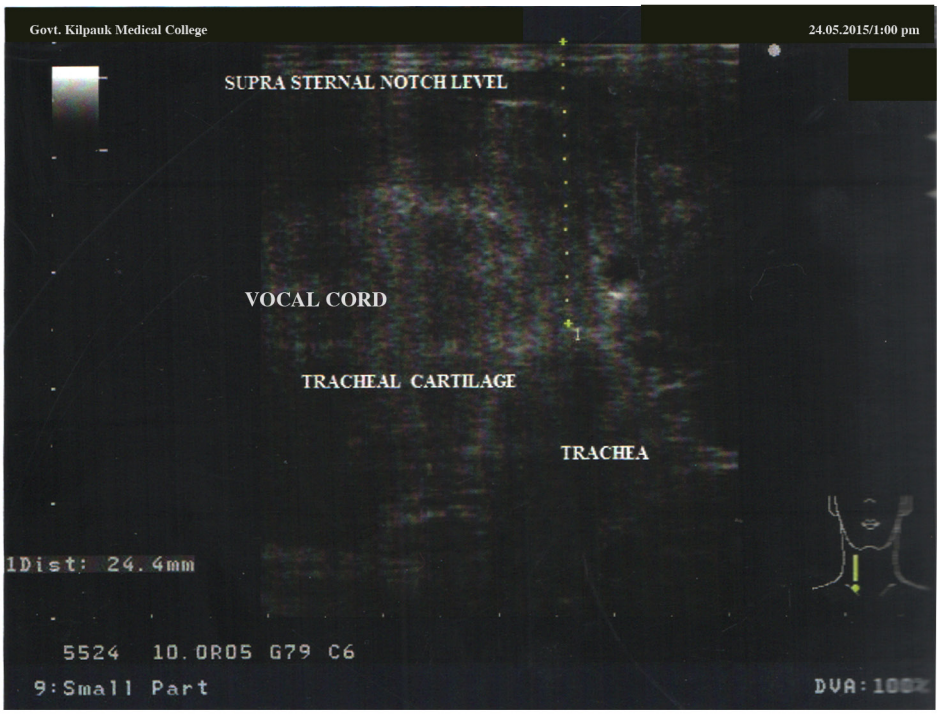
NECK CIRCUMFERENCE:Neck circumference of study population divided into three categories(<35 cm,35-40 cm,>40cm).In my study 17 out of 100 patients had neck circumference <35cm ,71 out of 100 patients had neck circumference in the range of 35-40 cm and the remaining 12 patients had neck circumference > 40cm .

In my study in patients with neck circumference in the range of 35-40 cm only 11 out of 71 patients had IDS score ≥1 and in patients with neck circumference >40cm only 4 out of 11 patients had IDS score ≥ 1.The results were subsequently analysed with Chi-square test and it showed that the correlation of increased neck circumference with difficult intubation was statistically significant but less than when compared to pretracheal soft tissue thickness.

This result is comparable with study conducted by Delanoue et al.

ANTERIOR SOFT TISSUE THICKNESS

AT SUPRA STERNAL NOTCH



INTUBATION DURATION:

The mean time to intubate was 15 seconds.Intubation time range was 10 to 25 seconds.68% were intubated in 10 to 15 seconds.

In the study conducted by Ishwar singh et al intubation was possible in 88% of cases within stipulated time of one minute and mean time of 28.6 seconds.

In my study in patients with anterior soft tissue thickness in the range of 11.5-12.4mm out of 10 patients 3 were intubated in 15-20 seconds and in patients with anterior soft tissue thickness in the range of 12.5-13.4 mm out of 6 patients 1 was intubated in15-20 seconds ,3 were intubated in>20 seconds.The results were subsequently analysed by using Chi-square test and statistically significant correlation was obtained between anterior soft tissue thickness and intubation duration.P value=0.0001.

My study results show that ultrasonogram guided measurement of pretracheal soft tissue thickness was a better predictor of difficult airway than neck circumference from the observations.The results are comparable to Ezri etal study.

SUMMARY

Title :

A prospective comparative cross sectional study to compare the relevance of ultrasound guided measurement of pretracheal soft tissue thickness and neck circumference preoperatively in predicting difficult airway

Keywords :

Ultrasound,Difficult airway prediction,Airway assessment,Neck circumference,Cormack-Lehane classification,Intubation difficulty scale, Soft tissue thickness in neck.

Aim:

To study the usefulness of ultrasonogram guided measurement of anterior soft tissue thickness of neck and neck circumference in predicting difficult airway.To help the anaesthesiologist in planning the airway management in difficult airway patients

Methods :

100 patients who were to undergo elective surgery and required endotracheal intubation were included in the study.Patients with no teeth and head and neck anatomical abnormality were excluded from study. On the previous day evening

of surgery, Patients were shifted to the ultrasound room in the Department of Anaesthesiology,Govt.Kilpauk Medical College and clinical airway assessment which included Mallampatti's classification, inter incisor gap and thyromental distance,neck circumference were measured.The ultrasound airway assessment was done to measure the thickness of soft tissues in the anterior neck at 3 levels namely (a) vocal cords, (b) thyroid isthmus and (c) suprasternal notch and their mean value was noted.The patient's demographic details like age, sex, height and weight were also recorded.On the day of surgery, the attending anesthesiologist provided anesthesia to the patient according to the standardization measures explained to them by the anesthetists who performed the airway assessment.The Cormack-Lehane grading ,Intubation difficulty scale and intubation duration were recorded.Statistical analysis was done using the collected data.

Results :

The statistic analysis tools that were used in this study for comparison between demographic variables, ultrasound measurements,neck circumference and Intubation Difficulty Scale,Cormack-Lehane classification were independent t test and Chi square test.

The ultrasound measurements made at the 3 levels (a)vocal cords (b) thyroid isthmus and (c) suprasternal notch level and the mean value showed significant

results. The P values for association anterior soft tissue thickness and CL grading ,IDS ,Intubation duration are P=0.0004, P=0.0004 ,P=0.0001 respectively. Neck circumference measured in cm at the level of thyroid notch.The P values for association between neck circumference and CL grading and IDS are P=0.046. From the above observations it can be concluded that ultrasonogram guided measurement of anterior soft tissue thickness is more relevant than neck circumference in predicting difficult airway.

CONCLUSION

It can be concluded that ultrasound guided measurement of anterior soft tissue thickness of neck is more relevant than neck circumference in predicting difficult airway.

BIBLIOGRAPHY

1) Hiremath AS,Hillman DR,James AL,Noffsinger WJ,Platt PR,Singer SL,Relationship between difficult tracheal intubation and obstructive sleep apnea. Br Journal Anaethesia 1998;80:606-11[Pubmed]

2) Bond A,Obesity and difficult intubation,Anaesthesi aintensive care,1993;21;828-30[Pubmed]

3) Caplan R A, Posner K L, Ward RJ, Cheney F W. Adverse respiratory events in anaesthesia : closed claims analysis : Anaesthesiology 1990 : 72 : 828 - 33

4) Mallampatti's SR, Gatt SP, Gugino LD, Desai SP, Waraksa B, Freiberger D, Liu PL. A clinical sign to predict difficult tracheal intubation: a prospective study. Canadian Anesthetists Society Journal 1985; 32: 429-434

5) BrodskyJB,Lemmens HJ,Brock-Utne JG,Vierra M,Saidman LJ,Morbid obesity and tracheal intubation,Anaesth Analg,2002;94;732-6[Pubmed]

6) Ezri T,Medalion B,Weisenberg M,Szmuk P,Waiters RD,Charuzi I.Increased body mass index is not a predictor of difficult laryngoscopy.Can Journal Anaesth 2002;50:179-83[Pubmed]7)

7) Samsoon GLT, Young JRB. Difficult tracheal intubation: A retrospective study. Anesthesia 1987; 42: 487-490.

8) Patil VU, Stehling LC, Zauder HL. Fibreoptic endoscopy in anesthesia. Year Book Medical Publishers Inc. 1983.

9) Rocke DA,Murray WB,Rout CC,Gouws F,Relative risk analysis of factors associated with difficult intubation in obstetric anaesthesia 1992;77;67-73.[Pubmed]

10) Cormack RS ,Lehane J,Difficult tracheal intubation in obstetrics. Anaesthesia,1984;39:1105-11[Pubmed]

11) Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anesthesia: a prospective blind study. Anesthesia and Analgesia 1995; 81: 254-58.

12) El Ganzouri AR, Mc Carthy RJ, Tuman KJ, Tanck EN, Ivankovich AD. Preoperative airway assessment: Predictive value of a multivariate risk index. Anesthesia and Analgesia 1996; 82: 1197-1204.

13) Arne J, Descoins P, Fusciardi J, Ingrand P, Ferrier B, Boudigues D et al. Preoperative assessment for difficult intubation in general and ENT surgery: Predictive value of a clinical multivariate risk index. British Journal of Anesthesia 1998; 80: 140-146.

14) Takahata O,Kubota M,Mamiya K,et al.The efficacy of the BURP maneuver during a difficult laryngoscopy,Anaesth Analg.1997:84;419-21[Pubmed]

15) Vaughan RS ,Predicting a difficult intubation,in difficulties in tracheal intubation.Latto IP and Vaughan RS,editors,1997,W.B.Saunders:London,p80-81

16) J.P.Kline. " Ultrasound guidance in anaesthesia" AANA Journal, vol. 79, no.3, pp. 209 - 217, 2011.

17) C.R. Falyar, "Ultrasound in anaesthesia : applying scientific principles to clinical practice". AANA journal Vol 78, no. 4 pp. 332 - 340, 2010.

18) A. Hatfield and A.Bodenham, " Ultrasound : an emergency role in anaesthesia and intensive care" British journal of Anaesthesia, Vol 83, no.5, pp - 789 - 800; 1999

19) Abe T,Kawakami Y,Sugita M,Yoshikawa K,Fukunaga T,Use of B-mode ultrasound for visceral fat mass evaluation;comparisons with Magnetic resonance imaging.Appl Human Sci,1995:14;133-9

20) Whittle AT,Marshall I,Mortimore IL,Wraith PK,Sellar RJ,Douglas NJ.Neck soft tissue and fat distribution;Comparison between normal men and women by magnetic resonance imaging.Thorax,1999;54:323-8[Pubmed]

21) Donald MY, Fung MD, Devitt JH. The Anatomy, Physiology and Innervation of the larynx. Anesthesiology Clinics of North America 1995; 13(2): 259-276.

22) Gal JT. Airway management. Miller's Anesthesia. 6th edition Elsevier – Churchill Livingstone 2005.

23) Ezri T, Gewurtz G, Sessler D J, et al. Prediction of difficult laryngoscopy in obese patients by ultrasound quantification of anterior neck soft tissue. Anaesthesia 2003; 58: 1111-4

24) Srikar Adikari et al; Pilot study to determine the utility of point-of-care Ultrasound in the assessment of difficult laryngoscopy. Academic emergency medicine 2011; 18: 754 – 758

25) Komatsu R, Sengupta P, Wadhwa A, et al. Ultrasound quantification of anterior soft tissue thickness fails to predict difficult laryngoscopy in obese patients. Anaesth. Intensive care, 2007; 35: 32 -7.

26) Ellis H, Feldman S. The respiratory pathway. Anatomy for anesthetists. 6th edition. Oxford Blackwell Scientific 1993

27) Horton WA, Fahy L, Charters P. Defining a standard intubating position using "angle finder." Br J Anaesth 1989;62:6–12

28) Zagzebski JA. Essentials of Ultrasound physics.St Louis, mo; mosby; 1996.

29) Edelman SK. Understanding Physics. 3d ed. Woodlands, Tx : ESP; 2004.

30) Szabo TL. Diagnostic Ultrasound Imaging: Inside Out. Burlington, MA:Elsevier; 2004

31) Singh M, Chin Kj, Chan Vw, Wong Dt, Prasad Ga, Yu E: Use of sonography for airway assessment: an observational study. J Ultrasound Med; 2010, 29:79-85.

32) Kundra P, Mishre SK, Ramesh A. Ultrasound of the airway. Indian J Anaesth 2011:55:456-62.

33) Loveday E. The larynx. In : Ahuja AT, Evans RM, editors. Practical Head and Neck Ultrasound. 1st ed. London: Greenwich medical media limited; 2000. P. 105-17

PROFORMA

NAME: AGE: SEX: IP NO:

DIAGNOSIS: SURGERY PLANNED:

PRE OPERATIVE ASSESSMENT;

HISTORY :

COMORBID ILLNESS AND TREATMENT DETAILS-

EFFORT TOLERANCE- METS

H/O PREVIOUS SURGERY(ANY DOCUMENTED DIFFICULT AIRWAY)

H/O BURNS/TUMOURS INVOLVING AIRWAY/TRAUMA

H/O SNORING/VOICE CHANGE

GENERAL EXAMINATION:

HEIGHT: WEIGHT: BMI:

ANAEMIA: JAUNDICE: CERVICAL SPINE: TONGUE:

PR: BP: RS: CVS:

AIRWAY EXAMINATION

GROSS ALTERATION IN AIRWAY ANATOMY:

HAIR BUN: BEARD:

NECK FLEXION: NECK EXTENSION:

INTER INCISOR DISTANCE: THYROMENTALDISTANCE:

STERNO MENTAL DISTANCE:NEUTRAL MAX EXTENSION :

UPPER LIP BITE TEST: NECKCIRCUMFERENCE:

RECEDING MANDIBLE: PALATE CONFIGURATION:

ANTERIOR SOFT TISSUE THICKNESS:

site	Vocal cord	Thyroid ishthmus	Supra sternal notch	Mean
mm				

DENTURES:

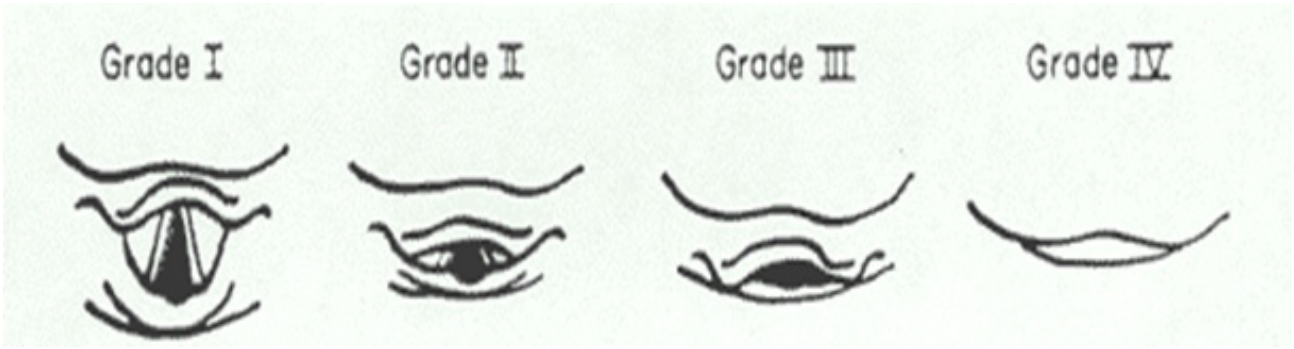
ARTIFICIAL(REMOVABLE/FIXED): BUCK TEETH: UPPERINCISORLENGTH:

LOOSE TEETH: CRACKED TEETH: ABSENT TEETH:

MODIFIED MALLAMPATTI CLASSIFICATION:

CLASS 1/2/3/4

COOKS MODIFICATION OF CORMACK &LEHANE GRADING:



a b a b

- NUMBER OF ATTEMPTS >1
- NUMBER OF OPERATORS >1
- NUMBER OF ALTERNATIVE TECHNIQUES
- CORMACK GRADE -1

- LIFTING FORCE REQUIRED

  NORMAL/ INCREASED

- LARYNGEAL PRESSURE

  NOT APPLIED

  APPLIED

- VOCAL CARD MOBILITY

  ABDUCTION

  ADDUCTION

N1	N2	N3	N4	N5	N6	N7	TOTAL

DURATION: SECONDS

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு

கீழ்ப்பாக்கம் மற்றும் ராயப்பேட்டா அரசு பொது மருத்துவமனையில் காற்றுக்குழாயின் மதிப்பீடு செய்ய கழுத்து மற்றும் கழுத்து சுற்றளவு முன்புற மென்மையான திசு தடிமனைச் செவியுணராஒலிவிழிக்கருவியின் வழிகாட்டுதல் மூலம் அளவீடு செய்து இணக்கப்படுத்தி ஒப்பிடுதல் குறித்து ஆராய்ச்சி செய்ய உள்ளோம்

ஆராய்ச்சி நிலையம்: மயக்கவியல் மருத்துவத் துறை,
கீழ்ப்பாக்கம் மருத்துவக்கல்லூரி மற்றும்
ராயப்பேட்டா அரசு பொது
மருத்துவமனை, சென்னை - 600 010.

பங்கு பெறுபவரின் பெயர்: **உறவு முறை:**

பங்கு பெறுபவரின் எண்:

பங்கு பெறுபவர் இதனை (✓) குறிக்கவும்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களைக் கேட்கவும், அதற்கான தகுந்த விளக்கங்களைப் பெறவும் வாய்ப்பளிக்கப்பட்டது.	☐
நான் இவ்வாய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்தக் காரணத்தினாலோ எந்தக் கட்டத்திலும் எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.	☐
இந்த ஆய்வு சம்மந்தமாகவும், மேலும் இது சார்ந்தஆய்வு மேற்கொள்ளும்போதும், இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளைப் பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்துகொள்கிறேன். நான் ஆய்வில் இருந்து விலகிக் கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.	☐
இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும், பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்திக் கொள்ளவும், அதைப் பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன்.	☐

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்குக் கொடுக்கப்பட்ட அறிவுரைகளின் படி நடந்துகொள்வதுடன், இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத வழக்கத்திற்கு மாறாக நோய்க்குறி தென்பட்டாலோ உடனே அதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதி அளிக்கிறேன்.

இந்த ஆய்வில் எனக்கு மருத்துவப் பரிசோதனை, காற்றுக்குழாயின் மதிப்பீடு செய்ய கழுத்து மற்றும் கழுத்து சுற்றளவு முன்புற மென்மையான திசு தடிமனைச் செவியுணராஒலிவிழிக்கருவியின் வழிகாட்டுதல் மூலம் அளவீடு செய்து இணக்கப்படுத்தி ஒப்பிடுதல் குறித்து ஆராய்ச்சி செய்து கொள்ள நான் முழு மனதுடன் சம்மதிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம் .....

இடம் ..... தேதி .....

கட்டைவிரல் ரேகை:

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

.....

.....

ஆய்வாளரின் கையொப்பம் .....

இடம் ..... தேதி .....

ஆய்வாளரின் பெயர் .....

ஆராய்ச்சி தகவல் தாள்

கீழ்ப்பாக்கம் மற்றும் ராயப்பேட்டா அரசு பொது காற்றுக்குழாயின் மதிப்பீடு செய்ய கழுத்து மற்றும் கழுத்து சுற்றளவு முன்புற மென்மையான திசு தடிமனைச் செவியுணராஒலிவிழிக்கருவியின் வழிகாட்டுதல் மூலம் அளவீடு செய்து இணக்கப்படுத்தி ஒப்பிடுதல் குறித்து ஆராய்ச்சி செய்ய உள்ளோம்.

நீங்கள் இந்த ஆராய்ச்சியில் பங்கேற்க நாங்கள் விரும்புகிறோம். இந்த ஆராய்ச்சியில் பங்கேற்பதால் தங்களது நோயின் ஆய்வறிக்கையோ அல்லது சிகிச்சையோ பாதிக்கப்படாது என்பதையும் தெரிவித்துக் கொள்கிறோம்.

இந்த ஆராய்ச்சியின் முடிவுகளை அல்லது கருத்துகளை வெளியிடும் போதோ அல்லது ஆராய்ச்சியின் போதோ தங்களது பெயரையோ அல்லது அடையாளங்களையோ வெளியிடமாட்டோம் என்பதையும் தெரிவித்துக் கொள்கிறோம்.

இந்த ஆராய்ச்சியில் பங்கேற்பது தங்களுடைய விருப்பத்தின் பேரில் தான் இருக்கிறது. மேலும் நீங்கள் எந்நேரமும் இந்த ஆராய்ச்சியில் இருந்து பின்வாங்கலாம் என்பதையும் தெரிவித்துக்கொள்கிறோம்.

இந்த சிறப்புப் பரிசோதனைகளின் முடிவுகளை ஆராய்ச்சியின் போதோ அல்லது ஆராய்ச்சியின் முடிவின் போதோ தங்களுக்கு அறிவிப்போம் என்பதையும் தெரிவித்துக்கோள்கிறோம்.

ஆராய்ச்சியாளர் கையொப்பம் பங்கேற்பாளர் கையொப்பம்

தேதி:

PATIENT CONSENT FORM

Study Detail : TO COMPARE THE RELEVANCE OF USG GUIDED MEASUREMENT OF ANTERIOR SOFT TISSUE THICKNESS OF NECK AND NECK CIRCUMFERENCE AIRWAY ASSESSMENT

Study centre : GOVT. KILPAUK MEDICAL COLLEGE HOSPITAL & GOVT.ROYAPETTAH HOSPITAL

Patients Name :

Patients Age :

Identification Number :

Patient may check these boxes

I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

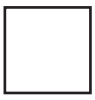
I understand that my participation in the study is voluntary and that I am free to withdraw at anytime without giving reason, without my legal rights being affected. ☐

I Understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff if I suffer from any deterioration in my health or well – being or any unexpected or unusual symptoms. ☐

I hereby consent to participate in this study.

I hereby give permission to undergo complete clinical examination and diagnostic tests including hematological, biochemical, radiological tests.



Signature/thumb Impression :

Patients Name and address :

Signature of investigator :

Study investigator's Name :

INFORMATION TO PARTICIPANTS

Investigator :

Name of the participant :

Title : To Compare the relevance of USG guided measurement of anterior soft tissue thickness of neck and neck circumference in airway assessment

You are invited to take part in this research study. We have got approval from the IEC. You are asked to participate because you satisfy the eligibility criteria.

What is the purpose of this research?

In this study USG guided measurement of anterior soft tissue thickness of neck and neck circumference how far they are correlated in predicting difficult airway is compared.

The study design:

Patient will be induced with Inj. Thiopentone 5mg/Kg. After induction of anaesthesia all patients were manually ventilated with sevoflurane 2-0-2.5% in oxygen and NDP Neuromuscular blocker.

Inj. Xylocard1.5mg/Kg. Intubation will be attempted after 3 minutes to obtain optimal intubating conditions. Thereafter lungs mechanically ventilated for the duration of the procedure and anaesthesia maintained using sevoflurane(1.25 – 1.75%) in a mixture of nitrous and oxygen at 2:1 ratio.

Benefits:

This study will help us in determining whether USG guided measurement of anterior soft tissue thickness of neck and neck circumference are good predictors of difficult airway.

Discomfort and Risks:

Postop sore throat, cough, hoarseness of voice as a result of intubation can occur but they can all be managed effectively.

Date :

Place :

Signature of the investigator: -

Signature/Thumb impression

of the participant

PATIENT DETAILS								
s.no	name	age	sex	ip no	surgery	height	weight	BMI
1	subramani	38	male	10098	lap hernia repair	162	50	19
2	mumtaz begam	32	female	10020	diagnostic laparoscopy	152	46	20
3	karunakaran	50	male	10028	open pyelolithotomy	170	56	20
4	kannan	46	male	10036	PCNL	178	66	21
5	annamalai	40	male	9832	rt,hemicolectomy	164	75	28
6	vasantha	30	female	8736	rt submandibular gland excision	150	81	36
7	manimekalai	49	female	8403	FESS	152	46	20
8	venkatraman	58	male	8723	rt.cortical mastoidectomy	170	58	20
9	joseph	32	male	7682	lap.appendicectomy	160	85	33
10	vignesh	22	male	6875	webster's procedure	162	52	20
11	mohammad jaffer	21	male	7896	lap.appendicectomy	156	45	20
12	sudhakar	54	male	7243	lap.cholecystectomy	160	96	40
13	vennila	24	female	7893	modified radical mastoidectomy	152	46	20
14	pradeep	34	male	9354	lumbar discectomy	170	52	18
15	thangam	25	female	9892	fibroadenoma excision	170	58	20
16	george	30	male	9472	lipoma back excision	170	56	20
17	fathima	20	female	12391	diagnostic laparoscopy	158	84	37
18	shanmugham	29	male	12468	cranioplasty	168	48	18
19	musafir ahmed	34	male	13823	lap.hernia repair	170	58	20
20	sudha	28	female	12384	renal transplant donor	152	42	18
21	bharath	30	male	9710	brachial plexus repair	160	100	39
22	chellakannan	34	male	2643	lap.rectopexy	152	42	18
23	daniel raj	28	male	3821	#clavicle-orif	170	52	18
24	ganesan	36	male	9816	FESS	166	55	19
25	Vijayalakshmi	50	female	9623	modified radical mastectomy	150	45	20
26	udhay	24	male	9843	lap.appendicectomy	178	66	22

s.no	name	age	sex	ip no	surgery	height	weight	BMI
27	jamuna devi	46	female	7946	lap.cholecystectomy	170	59	21
28	kalaiselvan	38	male	8248	radical nephrectomy	162	71	27
29	archana	24	female	7828	modified radical mastoidectomy	170	78	27
30	madhavan	30	male	8324	PBSC hand/contracture release/ fla[cover	150	61	27
31	regina	26	female	12683	#humerus-orif	150	45	20
32	jayanthi	32	female	12796	FESS	150	43	19
33	sasikumar	38	male	12832	modified radical mastoidectomy	168	65	23
34	loganathan	44	male	12848	lap.adhesiolysis	158	80	32
35	meganathan	56	male	11746	subtotal gastrectomy	168	79	28
36	kanniammal	38	female	11723	wide local excision breast cystisarcoma	150	43	19
37	catherine	42	female	10696	lap.cholecystectomy	164	91	34
38	valarmathi	33	female	11743	lap.appendicectomy	150	72	32
39	kavitha	28	female	11758	fibroadenoma excision	150	52	21
40	mahadevan	58	male	11779	brachial plexus repair	160	95	37
41	balu	32	male	12933	cortical mastoidectomy	170	84	29
42	anthony	37	male	10456	PCNL	171	55	19
43	akila	35	female	10555	lap.ovarian cystectomy	168	62	22
44	kumari	29	female	11623	lap.appendicectomy	152	42	18
45	sudarvizhi	39	female	11696	open pyelolithotomy	158	57	23
46	parameswari	54	female	9668	lap.assisted vaginal hysterectomy	154	94.8	40
47	suseendran	48	male	9423	lap.cholecystectomy	164	62	23
48	pandiyan	49	male	7856	lap.hernia repair	170	66	23
49	ekambaram	37	male	7610	#clavicle-orif	162	92	36
50	salim bai	45	male	7423	renal transplant donor	170	83	29
51	murugan	51	male	9981	subtotal gastrectomy	162	73	28
52	nandhini	32	female	6251	diagnostic laparoscopy	162	79	30

s.no	name	age	sex	ip no	surgery	height	weight	BMI
53	devika	35	female	5162	FESS	159	52	21
54	sabeena	23	female	6462	modified radical mastoidectomy	172	106	36
55	kabilan	31	male	6542	#humerus-orif	170	73	25
56	chandru	43	male	8622	PCNL	158	54	22
57	vimala	46	female	8851	lap.cholecystectomy	154	54	23
58	amal raj	38	male	9269	cortical mastoidectomy	171	85	29
59	renuka	39	female	8219	lap.ovarian cystectomy	156	53	22
60	shahida beevi	36	female	10209	nerve repair	158	82	33
61	sivaraman	32	male	11235	lipoma back excision	160	92	36
62	shankar	50	male	6892	lap.rectopexy	169	62	22
63	santhosh	36	male	7833	FESS	175	65	21
64	malarvizhi	32	female	9013	lap.appendicectomy	154	64	27
65	devi	39	female	8799	lap.cholecystectomy	164	86	32
66	vinodhini	42	female	12685	lap.adhesiolysis	158	54	22
67	sekar	44	male	11045	inverted papllioma nose removal	172	66	22
68	kalaiarasi	32	female	5604	open pyelolithotomy	154	62	26
69	pradheepa	27	female	6789	#soh orif	150	63	28
70	sugantha	37	female	4589	lumbar discectomy	152	51	22
71	suresh	36	male	10006	PCNL	168	79	28
72	jeyashree	25	female	11009	fibroadenoma excision	154	50	21
73	thilagavathi	29	female	12387	diagnostic laparoscopy	162	58	22
74	mannivannan	33	male	9585	modified radical mastoidectomy	162	91	35
75	kishore	35	male	8791	lap.hernia repair	156	51	21
76	latha	49	female	7966	modified radical mastectomy	162	68	26
77	mariappan	55	male	6932	subtotal gastrectomy	158	52	21
78	rayan jose	51	male	7509	simple nephrectomy	162	71	27
79	kamalakannan	47	male	12957	renal transplant donor	165	62	22
80	vasuki	45	female	5175	lap.assisted vaginal hysterectomy	156	51	21

s.no	name	age	sex	ip no	surgery	height	weight	BMI
81	tamilarasu	41	male	11537	lap.adhesiolysis	169	83	29
82	selvakumar	35	male	9731	tendon transfer	162	68	26
83	muthukrishnan	37	male	8624	cortical mastoidectomy	160	67	26
84	vimala devi	32	female	10356	FESS	152	62	27
85	parasuram	36	male	6713	brachial plexus repair	168	62	22
86	nalini	38	female	8049	septoplasty	169	83	29
87	mohammad ansil	29	male	7659	webster's procedure	172	65	22
88	kameshwaran	30	male	8916	lap.appendicectomy	175	65	21
89	paranthaman	40	male	9612	rt.hemiclectomy	162	58	22
90	rahul	33	male	7654	#clavicle-orif	166	62	22
91	hebsy	22	female	11297	fibroadenoma excision	162	58	22
92	naresh	23	male	13421	lap.appendicectomy	162	73	28
93	maheswari	34	female	10543	septoplasty	152	72	31
94	jamal	29	male	5823	nerve repair	152	62	27
95	amala	37	female	12984	lap.cholecystectomy	154	50	21
96	augustin	43	male	11456	cortical mastoidectomy	164	60	27
97	jerine mary	35	female	12690	lap.ovarian cystectomy	165	71	26
98	prakash	39	male	9653	lap.hernia repair	169	62	22
99	padmini	49	female	7631	modified radical mastectomy	160	51	20
100	ramakrishnan	54	male	9851	lumbar discectomy	171	59	20

Sl.no.	ULTRA SOUND				MAC	INTU-BA-TION DIFFI-CULTY SCORE									AIR-WAY AS-SESS-MENT							
	VOCAL CORD	ISTH-MUS	STER-NAL NOTCH	MEAN	C & L	N1	N2	N3	N4	N5	N6	N7	TO-TAL	DURA-TION (sec)	NK FLX	NK EXT	IID	TMD	SMD	ULBT	NK CIRC	MMC
1.	5.2	10	14.8	10	1	0	0	0	0	0	0	0	0	14	30	35	4.5	9	18	1	35	1
2.	5	10.2	14.8	10	1	0	0	0	0	0	0	0	0	16	35	35	5	10	19	1	35	1
3.	5	10	15	10	1	0	0	0	0	0	0	0	0	16	30	40	5	9.5	21	1	35	1
4.	4.9	8.8	19	10.9	2a	0	0	1	1	0	1	0	3	21	35	40	5	11	21	1	35	1
5.	4.6	11	15.9	10.5	2b	0	0	0	1	0	1	0	2	19	30	35	4.5	10	20	2	37	2
6.	5.8	16.5	15.5	12.6	1	0	0	0	0	0	0	0	0	14	35	40	3	8.5	17.5	2	43.5	2
7.	5.2	10	14.8	10	1	0	0	0	0	0	0	0	0	14	30	25	4.5	9	19	1	35	1
8.	5.4	10.2	15.4	10.3	1	0	0	0	0	0	0	0	0	12	30	30	4.5	9	21	1	36	1
9.	6	14	15.5	10.6	2b	0	0	1	1	0	0	0	2	18	35	35	4.5	11	21	1	38	2
10.	4.8	10.6	15.6	10.3	1	0	0	1	0	0	0	0	0	12	35	40	5	10.5	20.5	1	35	1
11.	5.4	10.2	15.4	10.3	1	0	0	0	0	0	0	0	0	14	35	35	4	8.5	19.5	1	35	1
12.	6	10.8	14.8	12.5	2a	0	0	0	1	0	1	0	2	19	35	35	4.5	10	19	2	45	2
13.	5.4	10	15.6	10.3	2a	0	0	0	1	0	0	0	1	12	30	40	4.5	11	19.5	2	35	1
14.	4.8	8	15.7	9.5	1	0	0	0	0	0	0	0	0	14	30	40	5	9	20	1	31	1
15.	5.2	8.4	16.1	9.9	1	0	0	0	0	0	0	0	0	14	30	35	4	9.5	20	1	31	1
16.	4.8	10.4	15.8	10.3	1	0	0	0	0	0	0	0	0	12	35	40	4.5	10.5	18.5	1	35	1
17.	6.5	10.2	14.8	12.5	3a	1	0	1	2	1	0	0	4	22	20	30	3.5	10.5	20	2	45.5	3
18.	4.6	8.2	15.8	9.5	1	0	0	0	0	0	0	0	0	14	25	40	4.5	19	21	1	33	1
19.	5.4	8.6	15.7	9.9	1	0	0	0	0	0	0	0	0	15	25	35	5	10.5	21.5	1	32	1
20.	4.8	8.1	15.6	9.5	1	0	0	0	0	0	0	0	0	18	30	40	5	9.5	21.5	1	31	1
21.	6	20.2	13.1	13.1	2a	2	0	1	0	0	0	0	3	21	25	25	4.5	11	19	2	45.5	3
22.	5.2	10	14.8	10	1	0	0	0	0	0	0	0	0	13	35	35	4.5	11	19	2	37	3
23.	4.8	10.4	15.8	10.3	1	0	0	0	0	0	0	0	0	16	35	35	4	9.5	21	1	33	1
24.	5.4	10.2	15.4	10.3	1	0	0	0	0	0	0	0	0	13	30	40	4.5	11	19	1	38	1
25.	4.8	8.6	15.6	9.5	1	0	0	0	0	0	0	0	0	14	35	40	5	10.5	21	1	37	1

Sl.no.	ULTRA SOUND				MAC	INTU-BA-TION DIFFI-CULTY SCORE								AIR-WAY AS-SESS-MENT							
	VOCAL CORD	ISTH-MUS	STER-NAL NOTCH	MEAN	C & L	N1	N2	N3	N4	N5	N6	N7	TO-TAL	DURA-TION (sec)	NK FLX	NK EXT	IID	TMD	SMD	ULBT	NK CIRC	MMC
26.	6.2	13.3	15	11	2a	0	0	0	1	0	0	0	1	16	30	35	4	9	18	1	38	2
27.	5.8	13.2	14.4	11.4	2a	0	0	0	1	0	0	0	1	18	35	40	4.5	9	20	1	38	2
28.	6	13.8	12	10.6	1	0	0	0	0	0	0	0	0	14	35	35	4.5	9	19	1	37	1
29.	6.2	13.6	12	10.6	1	0	0	0	0	0	0	0	0	13	30	35	5	10	19.5	1	37	1
30.	6.4	13.6	11.8	10.6	1	0	0	0	0	0	0	0	0	14	35	40	4.5	11	20	1	38	1
31.	4.6	11.2	14.2	10	1	0	0	0	0	0	0	0	0	16	30	40	5	10	21	1	37	1
32.	5.6	9.2	14.2	9.6	1	0	0	0	0	0	0	0	0	16	30	35	5	11	19	1	31	1
33.	5.4	10.2	15.4	10.3	1	0	0	0	0	0	0	0	0	15	35	35	5	10	21	1	43	1
34.	7.2	13	14	11.4	1	0	0	0	0	0	0	0	0	14	35	40	5	9.5	21	1	39.5	1
35.	4.8	12	15.2	10.6	1	0	0	0	0	0	0	0	0	13	35	40	4.5	9	19	1	39	1
36.	4.8	10.6	15.6	10	1	0	0	0	0	0	0	0	0	21	35	35	4.5	9.5	21.5	1	38	1
37.	6.4	14	14.8	11.7	1	0	1	0	1	0	0	0	1	13	35	35	5	9	19	1	39	1
38.	5.4	10	16.1	10.5	1	0	0	0	0	0	0	0	0	14	35	35	5	9	21	1	39	2
39.	5.2	10	14.8	10	2a	0	0	0	1	0	0	0	1	16	35	40	5	10	21	1	37	2
40.	5.4	17	13.6	12	1	0	0	0	0	0	0	0	0	12	25	35	4.5	10	20	1	44	2
41.	5.2	9.2	17.6	10.3	1	0	0	0	0	0	0	0	0	14	35	30	4.5	11	21	1	38	1
42.	5	8.2	15.4	9.5	1	0	0	0	0	0	0	0	0	20	35	40	4.5	10	19.5	1	32	1
43.	5.2	10	14.8	10	1	0	0	0	0	0	0	0	0	14	35	35	4.5	9	21	1	36	1
44.	5.8	8.8	14.4	9.6	1	0	0	0	0	0	0	0	0	17	25	35	5	11	19.5	1	32	1
45.	5.4	9.8	14.8	10	1	0	0	0	0	0	0	0	0	12	35	40	4.5	9.5	21	1	33	1
46.	7	17.4	14.8	13.1	2b	1	0	1	1	1	1	0	5	21	35	40	4.5	10	20	1	43.4	2
47.	5.3	16.3	14.1	11.9	2a	0	0	0	1	0	1	0	2	18	35	30	3.5	9.5	19	1	36	1
48.	5.2	10.4	14.4	10	1	0	0	0	0	0	0	0	0	14	30	30	4	10	19	2	34	1
49.	6	16	14	12	1	0	0	0	0	0	0	0	0	12	35	35	5	10	21	1	43	1
50.	5.2	9.2	17.6	10.6	1	0	0	0	0	0	0	0	0	13	30	30	4.5	10	21	1	37	1

Sl.no.	ULTRA SOUND				MAC	INTU-BA-TION DIFFI-CULTY SCORE								AIR-WAY AS-SESS-MENT							
	VOCAL CORD	ISTH-MUS	STER-NAL NOTCH	MEAN	C & L	N1	N2	N3	N4	N5	N6	N7	TO-TAL	DURA-TION (sec)	NK FLX	NK EXT	IID	TMD	SMD	ULBT	NK CIRC	MMC
51.	4.6	11	15.9	10.5	1	0	0	0	0	0	0	0	0	17	35	35	4.5	9	19	1	35	1
52.	6.4	13	14.8	11.1	1	0	0	0	0	0	0	0	0	14	30	40	4.5	9	21	1	39	1
53.	5	9.6	15.4	10	1	0	0	0	0	0	0	0	0	14	35	35	4.5	9.5	20.5	1	35	1
54.	5.5	17.6	13.9	12.3	1	0	1	0	0	0	0	0	1	12	35	35	4.5	11	19	1	43	1
55.	5.4	10.2	15.4	10.3	2a	0	0	0	1	1	1	0	3	21	20	20	4	8	16	2	35	3
56.	5.4	9.2	15.4	10	1	0	0	0	0	0	0	0	0	14	35	40	5	11	21	1	35	1
57.	6.8	10.6	14.7	10.5	1	0	0	0	0	0	0	0	0	13	35	35	5	11	21	1	38	1
58.	5.2	9.2	17.6	10.6	1	0	0	0	0	0	0	0	0	14	30	25	5	10.5	21	1	38	1
59.	4.6	11.2	14.2	10	1	0	0	0	0	0	0	0	0	14	30	40	5	10.5	19.5	1	36	1
60.	6	14	15.2	11.7	2a	0	0	0	1	1	1	0	3	18	30	30	4.5	11	21	1	36	2
61.	6.2	16.2	13.6	12	1	0	0	0	0	0	0	0	0	14	30	35	5	9.5	21	1	43	1
62.	5.4	10	14.6	10	1	0	0	0	0	0	0	0	0	14	35	35	4.5	9	19	1	36	1
63.	5.6	10.2	14.2	10	1	0	0	0	0	0	0	0	0	13	30	40	4.5	9.5	19	1	35	1
64.	6	10	15.5	10.5	1	0	0	0	0	0	0	0	0	14	30	40	5	10	21	1	38	1
65.	6	13	14.4	11.4	1	0	0	0	0	0	0	0	0	14	35	35	5	9.5	21	1	39	1
66.	4.8	10.4	15.8	10.3	1	0	0	0	0	0	0	0	0	14	30	35	4	9.5	19	1	36	2
67.	5.6	10	14.4	10	1	0	0	0	0	0	0	0	0	12	35	40	5	9	19.5	1	35	1
68.	6.2	10.1	16.8	10.9	1	0	0	0	0	0	0	0	0	13	35	40	4.5	10	21	1	37	1
69.	5.8	13.8	12.2	10.6	1	0	0	0	0	0	0	0	0	12	30	40	4.5	10.5	20	1	37	1
70.	5.6	10.2	14.2	10	1	0	0	0	0	0	0	0	0	12	35	40	5	10	21	1	35	1
71.	6.6	10	14.9	10.5	1	0	0	0	0	0	0	0	0	14	30	35	5	10.5	21	1	38	1
72.	5.8	10.6	13.6	10	1	0	0	0	0	0	0	0	0	12	35	40	4.5	11	19.5	1	35	1
73.	5.2	10.2	15.6	10.3	1	0	0	0	0	0	0	0	0	14	30	40	4.5	10	19	1	36	1
74.	6.2	14.2	14.8	11.7	1	0	0	0	0	0	0	0	0	14	35	35	5	9.5	19	1	42	1
75.	5.8	10.4	13.8	10	1	0	0	0	0	0	0	0	0	13	30	39	4.5	11	21	1	36	1

Sl.no.	ULTRA SOUND				MAC	INTU-BA-TION DIFFI-CULTY SCORE								AIR-WAY AS-SESS-MENT							
	VOCAL CORD	ISTH-MUS	STER-NAL NOTCH	MEAN	C & L	N1	N2	N3	N4	N5	N6	N7	TO-TAL	DURA-TION (sec)	NK FLX	NK EXT	IID	TMD	SMD	ULBT	NK CIRC	MMC
76.	6	13.6	12.2	10.6	1	0	0	0	0	0	0	0	0	17	30	35	4.5	9.5	19.5	1	38	1
77.	5.7	10.5	13.8	10	1	0	0	0	0	0	0	0	0	12	35	40	4.5	10.5	20	1	35	1
78.	6	13.6	12.4	10.6	1	0	0	0	0	0	0	0	0	14	30	35	4.5	11	21	1	37	1
79.	5.4	10	15.6	10.3	1	0	0	0	0	0	0	0	0	14	30	40	5	9.5	19.5	1	32	1
80.	5.4	10.6	14	10	1	0	0	0	0	0	0	0	0	13	35	30	5	10.5	19	1	36	1
81.	6.2	13	15	11.4	1	0	0	0	0	0	0	0	0	14	35	40	5	11	19.5	2	39	1
82.	6	9	14	9.6	1	0	0	0	0	0	0	0	0	12	35	35	5	11	21	1	30	1
83.	5.2	10.8	14	10	1	0	0	0	0	0	0	0	0	14	30	30	4.5	11	19.5	1	35	1
84.	5.6	10	15.9	10.5	1	0	0	0	0	0	0	0	0	13	30	35	4.5	10	21	1	37	1
85.	5.1	10.9	14	10	1	0	0	0	0	0	0	0	0	14	35	35	4	9.5	20	1	36	1
86.	4.9	8.8	19	10.9	1	0	0	0	0	0	0	0	0	13	35	35	4.5	9.5	20	1	40	1
87.	5.4	10.2	15.4	10.3	1	0	0	0	0	0	0	0	0	14	30	40	5	9.5	19	1	33	1
88.	4.8	11	14.2	10	1	0	0	0	0	0	0	0	0	15	35	40	4	9.5	21	1	35	1
89.	6.2	16.2	13.6	12	1	0	0	0	0	0	0	0	0	16	35	35	3.5	11	21	1	36	1
90.	6	14	12.2	10.6	1	0	0	0	0	0	0	0	0	17	30	35	4.5	11	21	1	37	1
91.	7.2	17	15	13.1	1	0	0	0	1	0	1	0	2	14	35	35	5	11	21	2	31	1
92.	4.8	12	15.2	10.6	1	0	0	0	0	0	0	0	0	16	30	35	4.5	9.5	21	1	37	1
93.	5.6	10	15.9	10.5	1	0	0	0	0	0	0	0	0	13	35	35	4	9.5	20	1	39	2
94.	6	10.1	16.6	10.9	1	0	0	0	0	0	0	0	0	14	35	40	4.5	9.5	19.5	1	38	1
95.	5.4	10.4	13,2	10	1	0	0	0	0	0	0	0	0	16	35	40	5	10	19	1	35	1
96.	6	9.8	16.9	10.9	1	0	0	0	0	0	0	0	0	14	35	40	4.5	9.5	19.5	1	38	1
97.	6	17.5	11.7	11.7	2a	0	0	0	1	1	1	0	3	19	30	35	4.5	9	21	1	38	2
98.	5.6	10.4	14	10	1	0	0	0	0	0	0	0	0	14	35	25	4.5	11	19.5	1	36	2
99.	4.8	8	15.8	9.5	1	0	0	0	0	0	0	0	0	14	30	35	4.5	9	21	1	33	1
100.	5.8	8.8	14.4	9.6	1	0	0	0	0	0	0	0	0	12	35	35	5	11	19	2	32	1